# SCIENTIFIC AMERICAN

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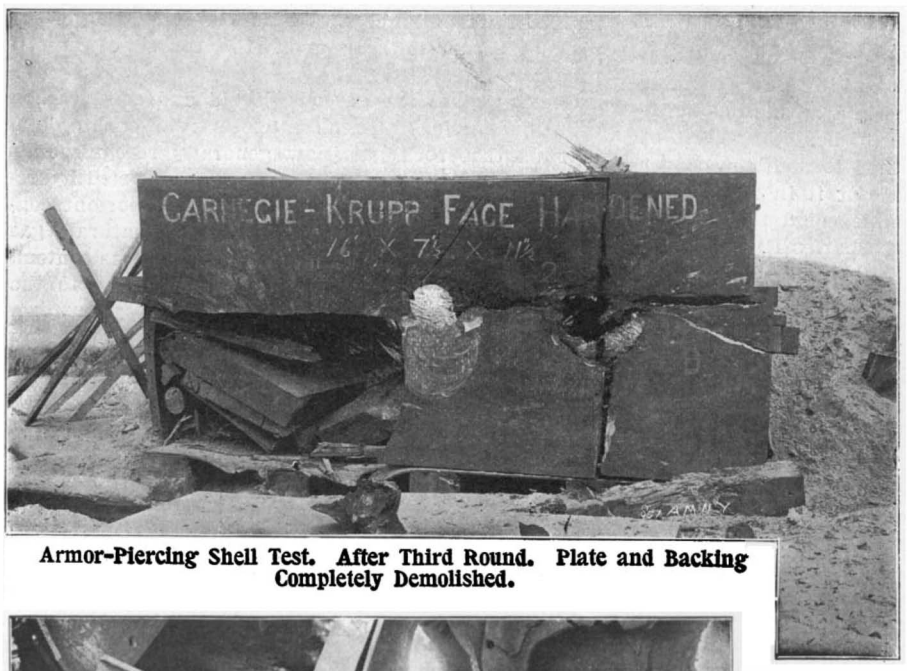
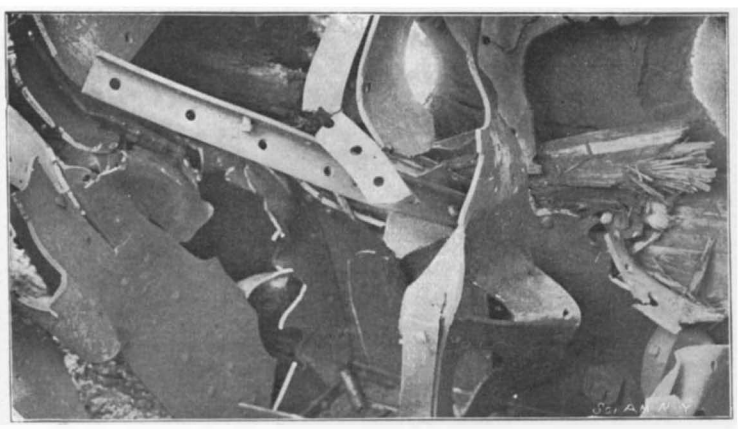
Armor-Piercing Shot Test. First Round. Plate Penetrated and Backing Wrecked.

Gathmann Shell Test. Target Before Firing, Backing Representing Side of "Iowa."

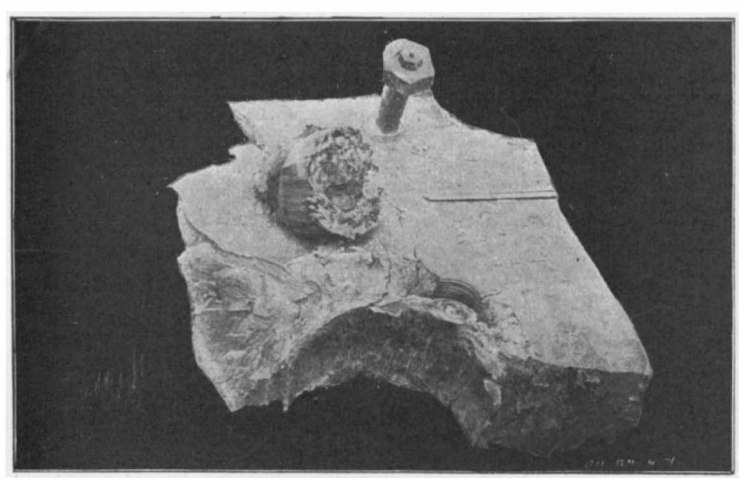



Armor-Piercing Shell Test. After Third Round. Plate and Backing Completely Demolished.

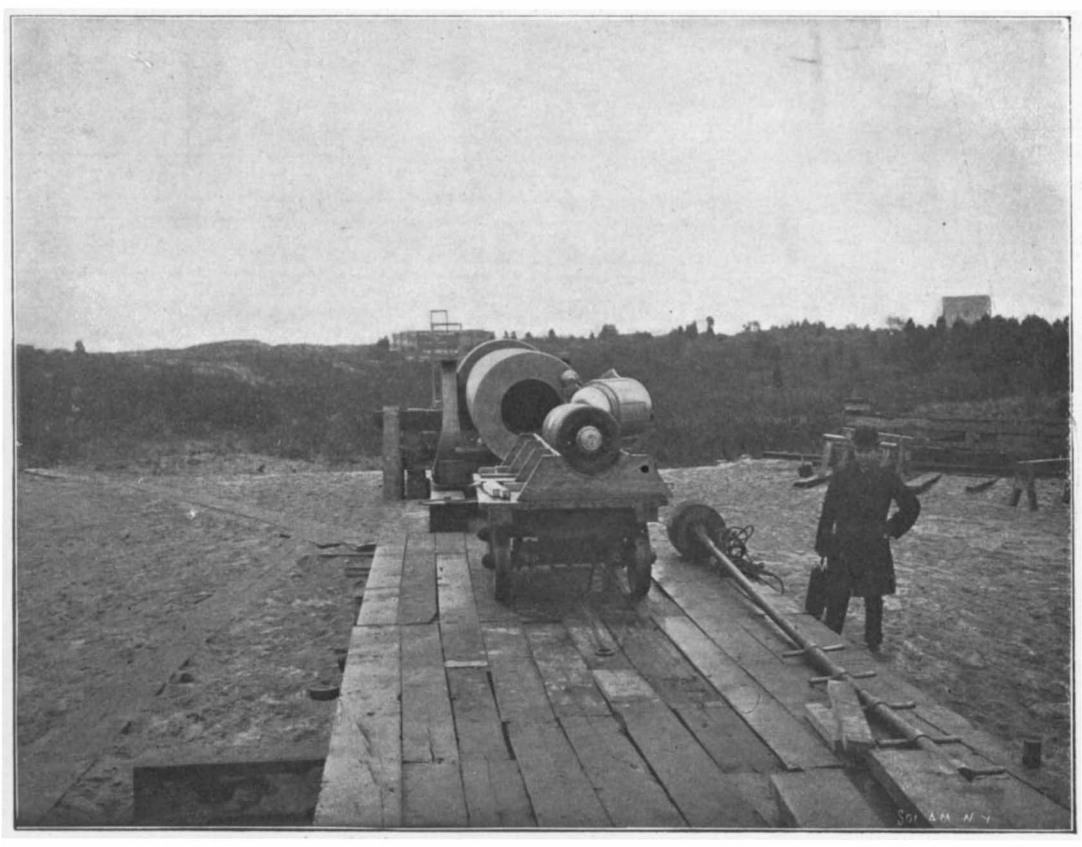
Gathmann Shell Test. Third Round. Target and Backing Driven 8 Feet to Rear and 8 Feet to Left of Original Position. Note Relative Position of Track and Target.




Armor-Piercing Shell Test. Rear of Target, Showing Extraordinary Destruction of Steel Frame Backing.

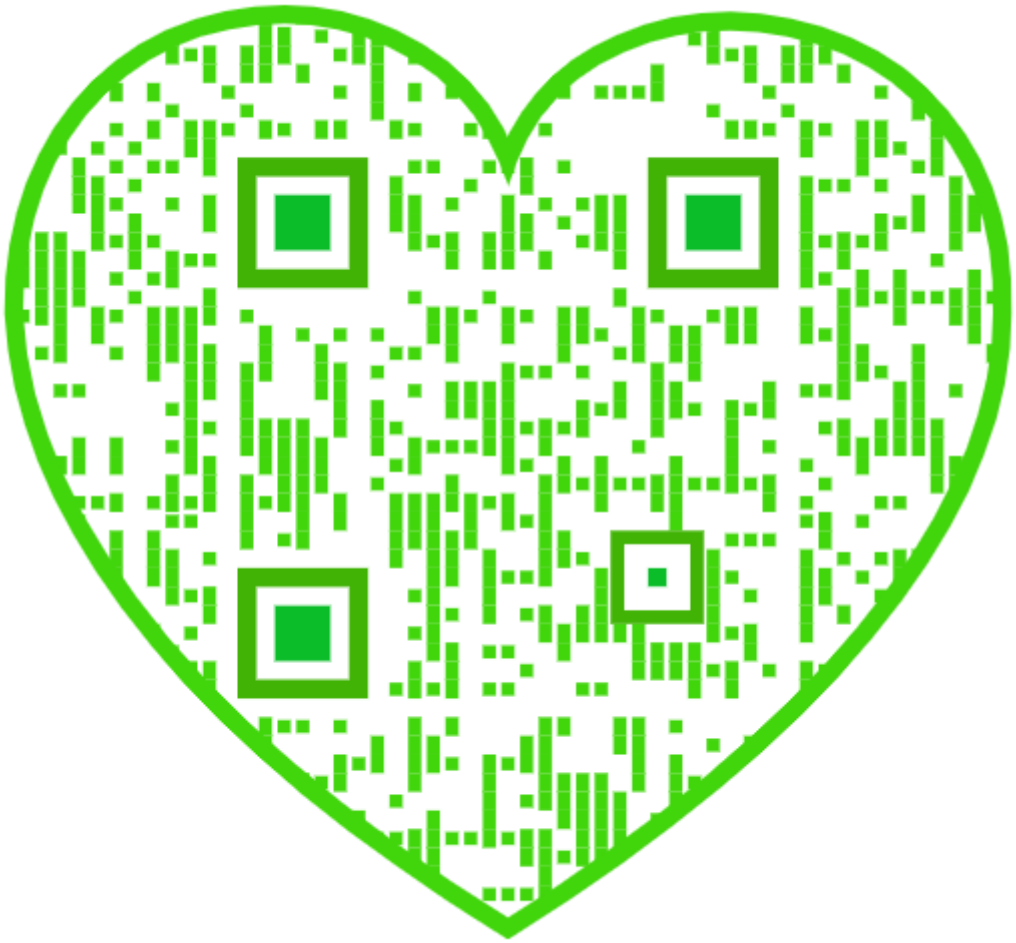



Armor-Piercing Shell Test. 1½-Ton Fragment of Plate Blown Through Backing and 200 Feet to Rear. Head of Shell Lying on Target.




Gathmann Shell Test. View from Rear of Gun, Showing Torpedo Shell; Screens and Target in Distance.

TESTS OF HIGH-EXPLOSIVE SHELL AT SANDY HOOK.—[See page 344.]



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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


## THE RECENT HIGH-EXPLOSIVE SHELL TESTS AT SANDY HOOK.

In the presence of such a brilliant success as has just been achieved by the new army high-explosive armor-piercing shell against heavy Kruppized armor plate, there is, of course, always a danger of overestimating its value; but we shall be within conservative limits when we state that this is one of the most phenomenal and epoch-marking achievements recorded in the history of the long contest between guns and armor, the credit in this case, however, being due to the projectile rather than to the gun. From their very first appearance high explosives have appealed strongly to the artillerist; for it has been realized that if they could be detonated either against or within the structure of a warship, they would produce enormously destructive effects. Experimentalists in the matter of throwing high explosives have been divided into two schools. One of these, represented by Zalinsky with his pneumatic dynamite gun and Gathmann with his torpedo shell, have claimed that it was only necessary to explode a large amount of guncotton against the side or deck of a battleship to blow in the structure and sink the vessel. The other school has claimed that high explosives would be comparatively ineffective if detonated on the outside of the armored portions of a ship, and that the only way to secure their full effect would be to carry them in armor-piercing shot and shell through the armored sides of a vessel and burst them in her interior.

The significance of the recent tests at Sandy Hook lies largely in the fact that the two systems were tried out under exactly equal conditions, and that in one of them at least it was proved that we have a combination of an explosive, a fuse and a shell, which has given the highest possible results that could be demanded, and has placed the very best modern armor plate completely at the mercy of the gun. We refer, of course, to the high-explosive, armor-piercing shell, loaded with either dunnite or maximite, and provided with the Dunn delay-action fuse, which latter is absolutely necessary to the detonation of the high-explosive filler. The results of the test, as shown on our front page, make it certain that the best-protected armorclad afloat, if attacked at pointblank range, would be speedily put out of action, either by the disablement of her guns, the destruction of her personnel, or the ultimate sinking of the ship itself.

With regard to the Gathmann test, it is our opinion that while the results are not comparable, in their effect upon the plate itself, to those achieved by the army shell, the effects produced upon the target as a whole were so tremendous as to render the Gathmann shell anything but the absolute failure which it has generally been pronounced to be. A shell that is capable of crumpling in, concertina fashion, the plate-steel framing of an "Iowa" and swinging the 12-inch Krupp plate with its steel and timber backing and several hundred tons of sand around, 8 feet to the rear and 8 feet to the left of its original position, is certainly entitled to be called something more than an absolute failure. At the same time it must be remembered that the target did not represent actual conditions; for had the plate been standing in its proper place on the side of a battleship, the lateral and vertical displacement which took place would have been impossible, since the plate would have been held in position by the strong armor shelf below, the 12-inch adjacent armor plates on either side of it, and by the mass of 6-inch side armor above it. Under such conditions it is quite a question whether the blast of the guncotton and the 52,000 foot-tons striking energy of the shell would have proved sufficient to crush in the plate-steel backing, representing the framing of the ship, in the way that it did in this test. The problem could only be settled by a trial under actual conditions. At the same time it is argued that it was the cushioning effect of the yielding plate frames that prevented the detonation from exerting its full effect upon the plate itself; and it is urged that had the plate been laterally and vertically supported, the energy of the detonation, which here showed itself in swinging the whole 700-ton mass of the target around to the left, would, had the plate been rigidly supported in the side of a ship, have expended its energy in smashing up the plate. It is possible, of course, that the tamping effect due to a more rigid backing would have concentrated the force of the detonation on the plate itself, and this contention is borne out by the fact that at Indian Head the detonation of 500 pounds of guncotton merely suspended against a 17-inch armor plate that was backed solidly against a cliff of wet clay, resulted in the complete demolition of the plate.

Justice to the Gathmann shell compels us to draw attention to these facts; but at the same time it must be remembered that a shell of the same size as the Gathmann filled with either maximite or dunnite, which have a greater density and far larger explosive energy, would have done more than the Gathmann shell, and would probably have smashed the plate into fragments. Moreover, the new army explosives are absolutely insensitive to shock; are perfectly safe to handle, and both the chemical composition and the delay-action fuse which is essential to their detonation are secrets which are in the safe-keeping of the United States army.

## A NEW THERMO-ELECTRIC COUPLE.

In 1827 the elder Becquerel showed that copper sulphide is strongly positive to ordinary copper. He pointed out that thermo-electric couples of copper sulphide and copper yield electromotive forces greater than those obtained from any other bodies which he had tried, such as iron sulphide and manganese peroxide. These researches were continued by Edmond Becquerel in 1865 and 1866. He showed that copper sulphide can be used for the construction of thermo-electric couples in contact with copper or German silver, and remarked that in order to obtain powerful effects the copper sulphide should be in a peculiar condition. He claimed that the best means of obtaining this peculiar condition was to heat the sheets of copper in sulphur vapor, and then to melt the copper sulphide thus obtained, and to cast it in molds at a temperature as nearly as possible equal to its melting-point. Eugene Hermite and Charles F. Cooper, of Paris, France, in a patent which they have received in the United States declare that they have proved that in this last point the younger Becquerel was in error. Becquerel obtained bars of sulphide having a fibrous fracture with bubbles disseminated through the mass. If the melting is repeated several times at a high temperature and if the homogeneous mass is cast, MM. Hermite and Cooper state that its thermo-electric power is merely destroyed. In spite of all his precautions Becquerel did not always obtain bars giving the same electromotive force.

Ruhmkorff stated that by adding to the copper sulphide a little antimony sulphide he obtained bars of a more uniform thermo-electric power. Finally Becquerel, continuing his researches, found that by reheating his bars of melted copper sulphide for several hours, the thermo-electric power became more regular. Becquerel constructed a thermo-electric battery in the laboratory with bars of fused copper sulphide thus obtained, covered at their ends with coils of German silver wire or copper. This battery gave an electromotive force relatively much higher than that obtained from any other thermo-electric couple studied; but the internal resistance of the battery was so great that it was of no practical use. Such was the state of affairs when Hermite and Cooper began their researches. As a result of their investigations they have reached the conclusion that copper sulphide properly prepared and coupled with certain metals is eminently fitted for the construction of industrial thermo-electric batteries.

The difficulties to be overcome are, first, to obtain copper sulphide in a form virtually quite homogeneous and offering the least possible electric resistance and at the same time yielding a constant electromotive force variable for given temperatures, and second, to make contacts between the copper sulphide and the metal employed which will be indestructible by heat, and which will at the same time suppress all accidental and useless resistance to the passage of the current. The inventors are probably the first to show an industrial method of using copper sulphide. Becquerel's battery was merely a laboratory curiosity.

The copper sulphide is melted and then cast in molds of sand to give it the form desired in the construction of the couples. The pieces obtained are placed in a crucible or furnace and heated to redness, whereupon they are subjected to the action of sulphur vapor for about half an hour. The piece absorbs the sulphur and increases in volume. If the crucible or furnace be opened, the piece will be seen surrounded by the blue flame of burning sulphur. Before the complete disappearance of this flame, the piece is withdrawn from the furnace and allowed to cool. In this condition the copper sulphide gives only a very weak electromotive force, and offers most resistance to the electric current. It is therefore replaced in a well-closed furnace and heated to bright redness for several hours under the exclusion of air, copper sheets or ingots being placed in the furnace to absorb the sulphur vapor involved.

This operation reduces the resistance considerably, and every piece gives a perfectly regular electromotive force of from two-tenths to three-tenths of a volt, depending upon the temperature to which it is heated. By adding a small amount of sulphide of iron it is found that the action of the final roasting is strongly resisted. Hermite and Cooper have found that the best metals for the contacts in the construction of thermo-electric couples are copper, German silver, silicon iron or steel, chrome iron or steel, platinum or platinum iridium, and chiefly commercial brass. Brass oxidizes much less than copper when hot; and strange to say, does not combine in a red heat with sulphur as copper does. The discovery that copper can be transformed into sulphide on the surface of brass is the key to the new method of preparing contacts on the bars or tubes of copper.

## THE GROWTH AND STATUS OF NATURAL GAS.

Aside from coal, gas now forms the most important fuel, and while much has been written concerning the decadence of the natural gas supply and the substitution of artificial gas produced from coal for the natural product, the fact remains that the natural gas production is still considerable, and this form of fuel has still a wide importance in industrial operations, although the supply at this day is not up to that of a few years ago, when the natural gas production was in the heyday of its existence. For ages natural gas escaping from the ground has been known to mankind. In primeval days it was venerated by the fire worshipers, and down through the ages we have faint records of its presence at various places, but it remained for modern days to effect the utilization of the product so as to bear upon the course of human progress.

Geology gives the gaseous, liquid and solid carbon compounds and bitumens a close relationship, and tells us that rock gas, now generally recognized as natural gas, is technically known as carbureted hydrogen and that marsh gas is one of its important constituents. Concerning the genesis of natural gas various hypotheses have been put forth. Some contend that its origin is organic, while others cling to the inorganic theory. Modern science is able to transform wood into lignite, and from that substance into bituminous coal, and it is now pretty well accepted that natural gas is the product of the slow decomposition of organic matter at a low temperature. In New York, Pennsylvania and other sections of the Appalachian field the gas pockets are mostly confined to the oil sands of the Devonian period, while in other sections they occur in the carbonaceous, the cretaceous, and the tertiary geological formations. Like petroleum, the natural gas belt seems to run around the world from Canada to California and northward from Hindostan to Wallachia, but it exhibits a less continuous sign than does petroleum. For twenty or thirty years the history of natural gas was coincident with that of petroleum, with the exception that the oil was utilized and gas despised. Nearly all the oil wells produced some gas, but its value was not early recognized, and for a long time wood was used to fire the boilers in oil-well drilling, while the gas was allowed to go to waste.

Probably the first attempts toward the utilization of natural gas were made in western Pennsylvania, where the oil industry was an important one as early as the middle of the last century, and it is certain that the first discovery of natural gas in this country was made in this section. The earliest record of the product dates back to 1823, when John Klingsworth, Philip Klingsworth and Nicholas Long struck a gas pocket at a depth of 300 feet while drilling a salt well near Grapeville, thirty miles east of Pittsburg. The gas rushed to the surface with great force, and, igniting, burned fiercely for months, but it was not until about fifteen years ago that the real value of the gas deposits at Grapeville were developed, and this field proved one of the most prolific in the country. For many years the existence of gas in Washington County, Pennsylvania, was known and throughout the oil regions of western Pennsylvania the product was invariably found.

One of the first natural gas companies organized in this country was the Fuel Gas Company, organized in Pittsburg in 1874. The organization of the Philadelphia Company in July, 1884, marked the real beginning of the natural gas industry, and the capital of the natural gas companies operating in Pittsburg in 1886 aggregated $20,000,000. That year saw a decided increase in the production and consumption of the product, and it was in that year that natural gas was first applied to the manufacture of glass. As early as 1885 the new fuel was responsible for the

employment of 10,000 additional men in the industrial establishments of Pittsburg, and during that year the new fuel displaced 2,500,000 tons of coal in the Pittsburg district.

In western Pennsylvania the natural gas industry reached its zenith in 1888, and the value of the product consumed in Pennsylvania in that year aggregated $20,000,000. The production of natural gas in the Pittsburg field in that year was something like 300,000,000,000 cubic feet. The success of natural gas in industrial operations was instantaneous, and through the introduction of this new fuel to Pittsburg in 1885 her manufacturing industries entered upon the most marvelous development witnessed in modern times. What bituminous coal in three-quarters of a century laid the foundation for, natural gas in one-tenth of the time built to quadrupled dimensions. The natural gas excitement increased the assessed valuation of real estate in Allegheny County, Pennsylvania, nearly $200,000,000 between the years 1885 and 1893. In 1884, before the introduction of natural gas to furnace operations, seventeen furnaces in Pittsburg produced 487,000 tons of pig iron. In 1890 there were twenty-five furnaces with a combined annual output of 1,489,000 tons. During the past decade there has been a gradual decline of the natural gas output in western Pennsylvania, and while the product still holds a prominent place in industrial operations, as well as for domestic heating and lighting, the effect of the application of this form of fuel to iron and steel and glass making has been far-reaching. The success of the new fuel paved the way for the introduction of artificial heating and illuminating gas, which industry is to-day a most important one in all parts of the country.

During the past decade many new gas fields have been exploited, and in this way the production has been kept to a fair average during the past ten or twelve years. In 1888 the value of the natural gas produced was about $22,000,000, while the value of the annual production at present exceeds $15,000,000. The value of the natural gas utilized in Pennsylvania in 1888 was $19,000,000, while the annual value of this product in that State to-day is about $7,000,000. The fields of Ohio and Indiana are about holding their own, while West Virginia has been a heavy gainer in the output of this product during the past year. There are at present over one thousand companies or individual concerns engaged in the production and marketing of natural gas. About 8,000 wells are now producing, and the 90,000,000 cubic feet of gas annually produced is carried to the points of consumption by nearly 18,000 miles of pipe, the product being used by more than half a million domestic fires, half a hundred iron mills and steel works, 200 glass houses and 3,000 other industrial establishments.

The general use of natural gas for industrial operations has done much to abate the smoke nuisance in cities, and with the economic use of this fuel its exhaustion will not be accomplished for years to come. Geologists have not yet settled conclusively whether or not gas is still forming, but the fact remains that many new wells are being brought in each year. A fact in connection with the introduction of natural gas into the iron and steel and allied manufacturing industries is that this fuel had the effect of greatly raising the standard of these products, and in many instances artificial gas is used to-day where natural gas is not obtainable, in order to produce the same results as are possible with natural gas. Pittsburg has always been foremost in the introduction of new fuels in industrial operations. It was in the iron and steel plants of that city that fuel coke was first used and there, too, natural gas was first adapted to the uses of modern industry. To-day Pittsburg stands pre-eminent among the industrial centers of the world so far as regards her fuel supply, and the part played and importance which the natural gas supply still holds with relation to the great iron and steel and varied manufacturing industries of the city are not to be overlooked in summing up the stupendous industrial development which has taken place about the headwaters of the Ohio. W. G. I.

## THE HEAVENS IN DECEMBER AND THE NEW STAR IN PERSEUS.

BY HENRY NORRIS RUSSELL, PH.D.

A triple planetary conjunction, no less remarkable than that of last month, takes place about the 15th of December. Jupiter and Saturn participate in it, as they did in the last one, but the third body is Mars. Moving slowly eastward, he passes Saturn in the morning of the 14th, and Jupiter on that of the 17th. While the two larger planets appear farther apart than a month ago, Mars passes much nearer them than Venus did. Unfortunately, all three are so near the sun, and in consequence so deep in the evening twilight, that Mars can hardly be seen, though Jupiter should be easily visible, and Saturn without much difficulty. The best time to look for them will be about half an hour after sunset.

### THE NEW STAR IN PERSEUS.

The most noteworthy current astronomical news relates to the new star in Perseus, or, rather, to its surroundings. A couple of months ago it was found that the new star is surrounded by a very faint nebula, so faint, in fact, that its brightest parts alone can be seen with the telescope, the rest being revealed only by photography. The photographs show that the form of the nebula is roughly circular, and that the luminous matter is gathered into nearly concentric circular streaks, so arranged about the new star as a center that there can be little doubt of the physical connection of the two.

Now comes a telegram from the Lick Observatory, stating that the brighter spots on the edge of the nebula are *moving*, supplemented by one from the Yerkes Observatory, a day later, saying that the nebula is probably expanding in all directions, and that this is certainly true of its southern (and brighter) half. As no such motion relative to the stars has ever before been detected in a nebula, this discovery would in any event be considered important, but its most sensational feature remains to be mentioned—the enormous rate of motion—one minute of arc in six weeks. This speed, at which it would take a body about three and a half years to traverse a distance equal to the moon's apparent diameter, may not seem at first to warrant the adjective that has just been applied to it. But when it is compared with the motions which have previously been observed among the stars, its true character at once appears.

The greatest proper motion—that is, velocity of a star among its neighbors—which has previously been known to science belongs to a small star in the southern hemisphere, which traverses 8¾ seconds of arc in a year. But the edge of this nebula is moving at the rate of over 500 seconds of arc a year, which is nearly sixty times as fast. When we come to translate this angular velocity into actual miles per second, we reach results that are yet more remarkable. If we assume that the nebula is as near as the nearest known star, the velocity of its edge comes out more than 2,000 miles a second—enough to carry it from the earth to the sun in twelve hours.

If the nebula is farther from us, the velocity is greater in proportion to its distance. Now the greatest velocity which any heavenly body (not moving in an orbit close to another) has previously been proved, or even supposed, to possess is about 200 miles per second. So we find ourselves faced with the following alternatives:

Either the new star in Perseus, and its surrounding nebula, are much nearer than any known star, or the velocity of expansion of the nebula is much greater than any which has previously been observed, or even suspected.

The first of the above alternatives seems on the face of it the more probable. It will soon be tested by observations for the parallax of the star. But, in any case, the velocity with which the luminous part of the nebula appears to move must be very great. One escape from the difficulty presents itself. It is possible that the gas of which the nebula is composed is normally dark, and that its shining is caused by some sort of impulse radiated out from the central star. Such a "wave" might travel very rapidly, although the gas as a whole was at rest, just as sound, in perfectly calm air, moves at the rate of eleven miles a minute.

In any case, however, it seems probable that Nova Persei and its nebula are much nearer than the average of the stars.

### THE HEAVENS.

The familiar winter constellations may be dismissed briefly. At 9 P. M., on December 15, Vega is just setting in the northwest, below Cygnus. Pegasus is low in the west, Andromeda above him, and Perseus in the zenith. Pisces, Cetus, and Eridanus fill the southern sky.

Gemini and Orion are well up in the east and southeast, with Auriga and Taurus above. The two dog-stars, Procyon and Sirius, lie below them. Cassiopeia is above the pole, Ursa Minor and Draco below, and Ursa Major on the right of the last.

### THE PLANETS.

Mercury is morning star throughout the month, but can only be seen during its first few days, as he is afterward too near the sun.

Venus is evening star in Capricornus. On the 4th she reaches her greatest elongation, being 47 deg. east of the sun. She approaches the earth and increases in brightness all through the month, and, as she is also moving northward, she becomes much more conspicuous, being visible for more than three hours after sunset. At the beginning of the month she appears telescopically as an exact half-moon, but by the end she has become a pronounced crescent.

Mars is evening star in Sagittarius, too near the sun to be well seen.

Jupiter and Saturn are also evening stars in Sagittarius, close together, but gradually drawing apart. By the end of the month they are too near the sun to be conspicuous.

Uranus is in conjunction with the sun on the 9th, and is quite invisible.

Neptune is in Gemini. He comes to opposition on the 22d, but can only be well seen with a large telescope.

### THE MOON.

Last quarter occurs on the afternoon of the 2d, new moon on the evening of the 10th, first quarter on the afternoon of the 18th, full moon on the morning of the 25th, and last quarter again on the morning of January 1.

The moon is nearest us on the 23d, and farthest away on the 8th. She is in conjunction with Mercury on the afternoon of the 9th, Uranus on that of the 10th, Mars, Jupiter and Saturn on the night of the 12th, Venus on the morning of the 15th, and Neptune on the night of the 25th.

At 7 o'clock on the morning of the 22d, the sun enters the sign of Capricornus, and, according to the almanacs, winter begins.

Princeton, N. J., November 19, 1901.

## SCIENCE NOTES.

The Jesup expedition (sent out by the American Museum of Natural History, New York city, to explore the unknown portions of Northeastern Siberia) has finished its work. The leaders, Norman C. Buxton, an American, and Aigenson (Jackelson?) have arrived at Moscow, after having traveled 5,000 versts (about 3,300 miles) in Kamchatka and other semi-polar districts. They have brought with them 100 boxes of collections for the American Museum of Natural History. Duplicates will be given to the St. Petersburg Academy of Sciences. The explorers have thoroughly investigated many tribes during the past fourteen months.

The scientific expert of the Indian Tea Association has issued a report on tea-seed oil and cake. Investigations show that tea-seed oil is clear, light, and yellow, but always has a more or less acrid taste. It cannot safely be used as an edible oil, owing to the presence of saponin, which is a constituent of the seed. For the same reason the tea-seed oil-cake is decidedly dangerous as a food for catle. As a manure it is far behind the other oil-seed cakes of commerce. The oil could be used as a lamp oil, and the cake might be useful as an insecticide. It was attempted, in 1885, to put tea-seed, as such, on the London market, under the name "tanne," but the seeds found no buyer, and the price asked sank quickly to a level far below the cost of importation.

The Century Magazine for October contains a short article on "How to Cross the Atlantic in a Balloon," by Prof. Samuel A. King, with an introduction by Prof. Cleveland Abbe. Prof. King deprecates the attempt to solve a problem of this character by means of flying machines or mechanically-propelled balloons, and thinks that the secret of success lies in mastering the problem of maintaining the ordinary spherical balloon at any required height by the aid of the drag rope or similar appliances. The author also points out the necessity of overcoming the propensity of the balloon to rise and fall with varying temperature, and suggests the use of a hood as a protection from solar radiation. With proper precautions, Prof. King considers a Transatlantic balloon voyage now quite within the range of feasibility.

Two remarkable caves have been discovered in France by Messrs. Capitan and Breuil, in which the walls are covered with drawn and painted figures of the paleolithic epoch. These are mostly figures of animals, and some of them have been drawn with striking correctness. In the first cave, at Combarelles (Dordogne), the figures are drawn with a deeply engraved line and are vigorous in execution. They include the mammoth, reindeer and other animals extinct in France. In the second cave, at Font-de-Gaume, not far from the former, black lines are used, and sometimes the whole animal is painted black, forming a silhouette. Red ocher is also used in the figures, which are sometimes four feet long. Many of the figures are covered with a stalagmite deposit which often reaches an inch in thickness.

An ingenious labor-saving machine, which will completely revolutionize the finger-ring manufacturing industry of England, has been devised by Mr. C. P. Denkin, a Birmingham jeweler. This machine effects in one almost instantaneous operation the work of several men. A signet ring fresh from the mold is placed in one tool of the Denkin invention, and within the space of a few seconds the inside is fixed, polished and lapped. The treatment of the face of the signet is equally simple and rapid. By means of an ingenious device it is clamped, and trained to a revolving surface of special design. In a short space of time the face is finished to perfection, whereas at present the ring has to pass through the hands of four skilled workmen. The process is so simple that it can be worked by a boy or girl, which means a considerable economy in the cost of production.

## USEFUL SPIDERS.

BY S. FRANK AARON.

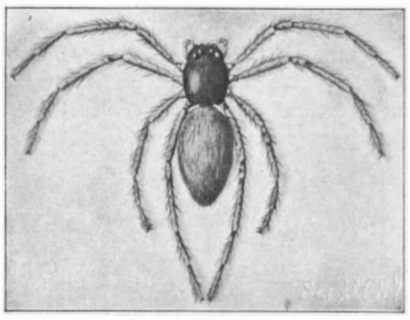
We should all try to understand the economy of nature. The time will surely come when we shall learn to regard all common forms of matter in their true character, when we shall realize that everything has its place in the great scheme, and when this understanding will fully influence our attitude toward creatures great or small, to us ill-favored or beautiful, beneficial or injurious. There is now much ignorance, often indifferent to truth, still oftener influenced by mere sentiment, concerning those creatures that have, often unaccountably, become to us loathsome and disgusting.

Spiders for example, as with snakes and lizards, as well as many insects are objects of almost universal antipathy. They are popularly believed to be harmful, poisonous, worse than useless, fit only to be shunned, feared, or trodden on. Few, even of the most sensible people, take any interest in spiders except to inquire as to their venomous qualities.

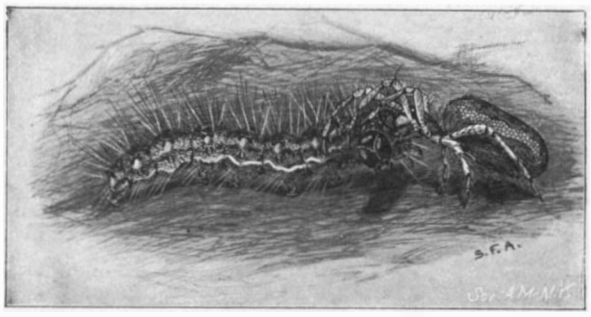
It must be admitted, of course, that their appearance is not in their favor. Few animated objects are more repulsive to the sight than the so-called tarantula of the tropics, a huge member of the spider family, and when to its ugliness is added its supposed poisonous character, it becomes a proper object of aversion. The great hairy-legged spiders of temperate climes are almost equally unsightly, and the popular notion endows them with venomous power, whether they deserve it or not. Even their handiwork, their delicate and truly wonderful webs of gossamer, are unnoticed except to be trodden down on the lawn, or brushed from the walls by the broom.

But it can be readily proved that spiders are rarely, if ever, poisonous or even harmful, that certain species are really useful and beneficial, and that they all play an important part in the great scheme of nature. Their chief service to man lies in their destruction of noxious insects. "To be sure," says the reader, "spiders kill flies, and flies are a nuisance." True, and flies are not only a nuisance; they are carriers of disease, spreaders of pollution. Spiders also kill mosquitoes, moths and other flying and crawling pests that stray into their webs.

The grassy-bank spider, *Agalena nævia*, whose dew-spangled web is often seen on the lawn in the early summer morning, preys upon many kinds of noxious insects. A larger species of Agalena, common in woods and about stone piles and fences, makes larger and stronger webs, in which bigger insects, such as locusts, grasshoppers, and June-bugs, are often trapped. The webs of all the Agalenas lead down into dark and secret tunnels where the spider retreats when danger threatens. Even the sudden visit of a wasp or a bumble-bee will sometimes drive the owner of the web into this hiding place.



A COMMON WEBWORM SPIDER.



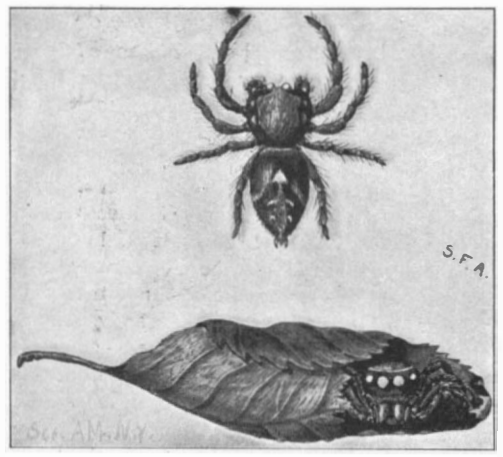
A WEBWORM SPIDER KILLING A WEBWORM.

The jumping spiders (*Attus*) are also active fly-catchers and destroyers of noxious insects. They build no web except a very small receptacle in which to hide their eggs and to protect their young when hatched. They are the tigers of the insect world, springing upon their prey with true feline energy. The orb-weavers, *Epeira*, are equally useful to man, and their webs reach the highest development of mechanical skill.

It is worthy of note that insects injurious to man form the chief prey of the orb-weaving and grassy-bank spiders, as well as of the jumping species. It is true that beneficial insects, such as ichneumon flies, dragon flies and predaceous beetles, may stray into their nests, but the noxious flies, the caterpillars, grasshoppers and leaf-eating beetles are their far more numerous victims.

But the most useful of all our spiders are those which prey upon the caterpillars that infest our shade and fruit trees and destroy their foliage. Attached to the branches of trees, particularly to the cherry, apple, maple, elm, ash and linden, may often be seen large, unsightly webs or nests, sometimes covering a good-sized branch. These nests are constructed by the larvæ of several kinds of web-worms, and each nest is the home of a colony of the worms, hiding there by day, and crawling forth at night to devour the surrounding leaves. A single web often contains hundreds of these worms, and were it not for a few spiders that also inhabit the nest and suck the life-blood of the caterpillars, the latter would undoubtedly increase in such numbers as to strip our fruit and shade trees almost bare of foliage. The webs which protect the caterpillars from birds also enable the spiders to feed in safety upon their prey. No webworm's nest is free from its spider parasites.

The willow web-worm, a closely allied species, found not only on willows but also on our common silver poplars, folding the leaves together in a smaller web, also has its spider parasites. But these intruders are by no means all of the same species. Some webs contain Attus spiders only; others harbor a spider with longer legs resembling the Epeira; and still others are infested by a spider of greater size. I have even seen all these various kinds living in the same

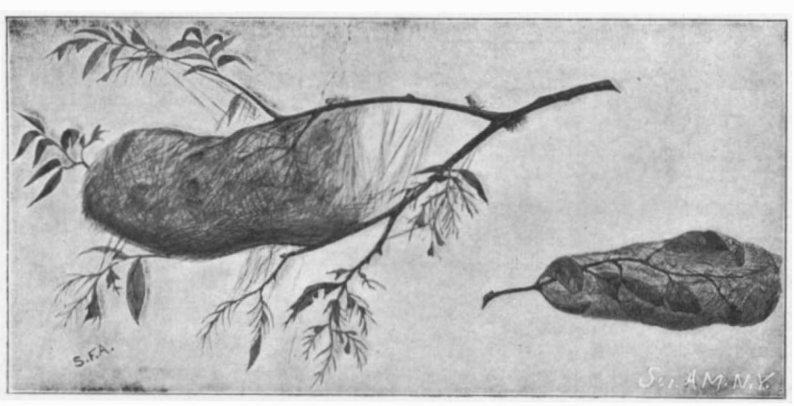


COMMON BLACK JUMPING SPIDER.—THE SAME IN POPLAR LEAF WEB OF WILLOW WEBWORM.

nest and devouring the unfortunate caterpillars at their leisure. This would seem an exception to the rule that "two of a trade can never agree."

The actual number of individual spiders in any one nest is never large, seldom more than four or five. It is remarkable that so few spiders can destroy so many caterpillars. They begin when the latter are very small, sucking their juices rapidly one after another and always leaving their bodies to dry up. It is probable that when a spider attacks a full-grown caterpillar, it absorbs only a part of the vital fluid—enough, however, to cause death. In many cases, the few spiders in such a nest manage to destroy every worm in the colony, leaving not one survivor.

May we not then realize that spiders can justly be classed among our most useful and beneficial forms of life? Too much can not be said in favor of protecting from destruction our insect-eating birds. But may not our humbler friends, the spiders, also enjoy our favor? Yet they can well protect themselves, and we can best promote our own interests by simply and fairly letting them alone.



WEBWORM WEBS OF HYPHANTRIA CUNEA.

WEB OF FULL-GROWN CATERPILLARS IN WILD BLACK CHERRY AND OF YOUNG CATERPILLARS IN ELM.

### The Population of the World.

Certain considerations arising from the great increase of population in Europe and North America during the last century formed the subject of Sir Robert Giffen's address to the Section of Economics and Statistics of the British Association for the Advancement of Science, says The London Standard. That increase has been enormous. France has grown from 25,000,000 to 40,000,000, Germany from 20,000,000 to 55,000,000, Russia (partly from annexation) from 40,000,000 to 135,000,000, the English population of the British Empire from 15,000,000 to 55,000,000, and the United States from rather over 5,000,000 to nearly 80,000,000. Altogether the growth is, in round numbers, from 170,000,000 to 510,000,000, or the space which, at the beginning of the century, was occupied by one person must now accommodate three. The white race, then, as a whole, need not trouble itself about either a yellow or a black peril; while in regard to its several members, as France now seems to be stationary, we have to concern ourselves, as far as numerical growth is concerned, only with Germany, Russia and the United States.

Anxiety is often felt in this country about our food supplies, and it is true that of late years we have imported them more and more largely; but this is also true to a greater or less degree of other European countries, and especially Germany. Such a country might, then, be in a serious plight in case of war, for it cannot be assumed that overland importation would be always possible, so it might suffer much as we should from a blockade of our coasts. The president also calls attention to one point which is often overlooked in predicting the evil results of the present growth in population. New markets, no doubt, thus become necessary, but these, it must be remembered, are by no means the only outlet for new energies. To a great extent the additional people provide for themselves. They procure for themselves the major part of the requisite comforts and luxuries of life. The main exchanges of any country, as a rule, are, and must be, at home, and the foreign trade, however important, will always remain within limits and bear some proportion to the total exchanges of the country.

But during the latter part of the century, while the increase of population has been universal, it has been in a decreasing ratio—even in the United States it has declined from something like 35 per cent in the earlier part to only 21 per cent in the last decade. It has also diminished in England, though the figures have been in all cases smaller. Such increase, it must be remembered, depends not only on the birth rate, but also on diminution of the death rate. That is brought out by the present almost stationary condition of France; the birth rate, no doubt, is rather low, 219 per 10,000, but its death rate is 211. This means a very slow growth indeed, but if the latter were reduced to the English rate, 183 per 10,000, very substantial increase would speedily result. All these considerations show what important ideas were suggested by the most common statistics, and thus indicate the need of a better statistical and economic education for our public men.

### New Process for Making Steel.

Trials have recently been completed at the Royal Technical High School, Berlin, of a new mode of steel manufacture, declared by experts as likely to have a revolutionary effect on the world's metal industry and progress. It is the invention of a Mecklenburg manufacturer named Giebeler, and consists in imparting to all grades of iron a strength and hardness surpassing nearly double that of the best known Harvey, Krupp or Boehler steel, while cheapening production 50 per cent. Projectiles hurled at armor plate, treated by the Giebeler process and 7¾ millimeters thick, made an impression of only 1 millimeter, while Kruppized armor, 4 millimeters thicker, was completely punctured. Resistance experiments showed even more astonishing results. Attempts made by powerful machines proved the steel to possess a strength of 165 kilogrammes per square millimeter, when the testing apparatus collapsed.

Among the peculiar features of the process is the increasing strength accruing as the steel grows cold. It is claimed that the process permits the metal to be worked cold or hot. Blades of the new steel cut other steel or iron into splinters as ordinary steel cuts into wood.

The representatives of Herr Giebeler will go to America with the intention of submitting the process to the great mills there.

At a rubber factory on the Continent a constant flow of fresh air is maintained in the spreading-room with the aid of an exhauster fixed near the floor. The vulcanizing-room is especially constructed for the purpose and has the vulcanizers on a lattice support raised three or four feet from the ground. Below the platform, and right down to the floor, the brickwork of the structure is provided on all sides with numerous airholes. The laborers are only slightly inconvenienced by the carbon bisulphide vapors. Formerly they were obliged to work with respirators, but they do not now require them.

## THE CAPE TO CAIRO TELEGRAPH.

BY ENGLISH CORRESPONDENT OF SCIENTIFIC AMERICAN.

The work of constructing the great telegraph line across Africa from Cape Town to Cairo is proceeding rapidly. The surveying party itself is now engaged in mapping out the last section of the route so far as the African Transcontinental Telegraph, as it is called, is concerned, namely, from Ujiji on the eastern shore of Lake Tanganyika to Mombasa on the eastern shore of the Albert Nyanza, the inland terminus of the Uganda Railway. It will be remembered that the idea of thus connecting the northern and southern extremities of this vast continent, and also providing a new trunk overland telegraph route to England, emanated from the Rt. Hon. Cecil Rhodes, and it is mainly through his energy and enterprise that the scheme is being realized. Certainly the construction of such a line, which when complete will measure approximately 5,600 miles in length, is a momentous achievement, especially when it is remembered that the greater part of the line extends through practically unknown country.

The two end sections of the line have been in operation for several years past, namely, from Cape Town through Cape Colony to Umtali in Matabeleland in the south; and from Cairo downward toward Khartoum in the north. The African Transcontinental Telegraph starts from Umtali, forming a junction with the Cape Colony Telegraph at that point. The portion of the line already constructed north of the Zambesi is divided into the following sections:

| | | | |
|---|---|---|---|
| Chiromo to Chikwawa | 67 | miles | 0 poles. |
| Chikwawa to Blantyre | 26 | " | 10 " |
| Blantyre to Zombra | 47 | " | 10 " |
| Zombra to Fort Johnstone | 77 | " | 10 " |
| Fort Johnstone to Dolmira Bay | 95 | " | 5 " |
| Dolmira Bay to Kolakola | 50 | " | 0 " |
| Kolakola to Bandawe | 78 | " | 0 " |
| Bandawe to Florence Bay | 94 | " | 17 " |
| Florence Bay to Karonga | 59 | " | 17 " |
| Karonga to Fife | 93 | " | 15 " |
| Fife to Abercorn | 104 | " | 0 " |

From Abercorn the line will strike in a northwesterly direction to the southern extremity of Lake Tanganyika to Bismarckburg, the frontier station of German East Africa. It will then continue along the eastern coast of Lake Tanganyika to Ujiji and thence stretch northeastward to Mombasa.

The survey party comprises the chief surveyor, Mr. Otto Beringer, two white assistants, and a sufficient army of blacks to carry their apparatus and necessities. The arduous nature of the task of this diminutive expedition can scarcely be comprehended. Their route extends through one of the most obscure, unaccessible, and pestilential parts of the dark continent. Fortunately the company possesses an indefatigable and thoroughly experienced African explorer in Mr. Beringer. He has devoted many years of his life to tramping through this country, and has thus become thoroughly acclimatized and acquainted with its natural conditions. This little band has often been completely isolated from civilization, in one or two instances being as much as 200 miles ahead of the constructional party. Natives have to be requisitioned by the surveyors for the conveyance of their baggage and also to assist them in their work. In the latter task Mr. Beringer has found them to be of exceptional use. They have grasped the nature and the peculiarities of the work very quickly, and have proved valuable assistants. This has been an inestimable boon, since had the natives not been available it would have necessitated the employment of more Englishmen, followed by a correspondingly increased death-rate. The natives are immune to the majority of those maladies, incidental to the tropics, which invariably prove fatal to Europeans.

The surveying has been carried out with commendable celerity, considering the difficult nature of the country traversed.

The material for the line is being wholly manufactured in England, and shipped to South Africa. Owing to a species of ant indigenous to the country, poles have had to be built of steel. Those for general purposes weigh about 160 pounds and measure 60 feet in height. In places, however, where the nature of the country necessitates an abnormally long span, longer and heavier poles are utilized. They are built in sections to facilitate transport. The material is shipped to the coast, transported to shallow-draught vessels, which proceed as far inland by means of the rivers as possible, and are then carried overland by oxen or natives.

The question of transporting the material up country has proved one of the greatest and most expensive difficulties in connection with the scheme. The country is so rugged or swampy on the whole that the inauguration of an oxen transport is almost impossible, so the natives have to be employed for the work. Quite a large army of several thousand blacks are requisitioned for this part of the work alone. Each man carries a load not exceeding 60 pounds.

In connection with the two lakes—Nyassa and Tanganyika—special vessels have been built for service upon them. Upon the latter lake there is now quite a small fleet of steamboats owned by the African Lakes

ERECTING THE FIRST POLE IN GERMAN EAST AFRICA ON THE RHODESIAN FRONTIER, SEPTEMBER, 1900.

Corporation and the African Flotilla and Transport Company. These vessels were built in England and Germany, and being of the shallow-draught type, were built in sections, taken to pieces, shipped to the African coast, conveyed across country to the shores of the lakes, and the parts there reassembled.

Several distribution depots and repair stations have been established at various points along the route to serve certain areas with the necessary materials. Karonga, at the northern end of Lake Nyassa, constitutes the depot station for the Tanganyika section, and here several thousand tons of material and stores are awaiting dispatch up country.

The construction expedition comprises 10 whites and 1,000 native laborers. The latter are engaged for two months at a time, and work from 5 A. M. to 6 P. M. As a rule the local currency is calico.

After the route has been surveyed, a broad track about 15 feet in width is cleared. The poles are

SHALLOW-DRAUGHT STEAMER FOR CONVEYANCE OF MATERIAL FOR CAPE TO CAIRO TELEGRAPH.

erected down the center of this path, so that the wire has a perfectly uninterrupted passage.

The most difficult section of the line from the constructional point of view was that between Fort Johnstone in the south end of Lake Nyassa, Bandawe, Florence Bay, and Karonga. From Fort Johnstone to Bandawe is a succession of thick undergrowth, marsh, and dense forests. During the rainy season, the major portion of this part of the country is immersed to a depth of seven or eight feet. The district is deadly pestilential, even to the natives, so that it is difficult to obtain local labor, and work can only be carried on for short periods.

From Bandawe to Florence Bay the route passes over extremely mountainous country. The sides of the hills are particularly steep, in many instances dropping sheer into the lake, with correspondingly wide ravines. To bridge some of the latter successfully, long spans have had to be made, in one or two instances amounting to as much as 750 feet.

The best constructed section of the line is that from Kolakola to Karonga. Although very mountainous and difficult to build, the telegraph between these stations can be worked with less battery power than on any other section, and with the exception of one or two spans which are strained a little too tightly, the line is well built.

During the year 1899 the contractors erected 325 miles of wire, of which 202 miles was the trunk line. The cost of the year's working amounted approximately to $99,925, exclusive of the purchase of the material in England and cost of transporting it up country. At Mombasa, the trunk line will join the Egyptian trunk line, which is being rapidly pushed southward from Khartoum to the Bahr-el-Ghaze, and the southern Egyptian frontier. It is anticipated by the provision of this new overland route to England that the cost of transmitting messages will be reduced to about 25 cents per word, as compared with $1.06, which is the present rate of the sea cable companies. The line will be much cheaper to maintain, and messages will be dispatched with greater celerity.

### Swiss Hydraulic Plant.

The Sublin hydraulic plant, which has been recently installed in Switzerland, is used to furnish light and power for several towns and also supplies current for the new Bex-Gryon-Villars electric railway. The motive power is supplied by the Avançon, an Alpine torrent whose flow is relatively constant throughout the year, as it is fed by numerous springs. It is already utilized by other hydraulic plants. Above the present site is a 600 horse power plant at La Peuffaire, which furnishes current for lighting several towns, and below are several other installations, including that of the Salines de Bevieux, which also takes 600 horse power. Between these is a difference of level of 570 feet, which is utilized by the new Sublin plant, and it obtains an average flow of 200 gallons per second. A masonry dam 24 feet long, 10 feet high, and 8 thick has been laid across the stream, and from here the water is brought by an underground canal 4,500 feet long to the main reservoir, constructed in armed cement, which is 25 feet in diameter and 10 feet deep, and serves as the starting point for the conduit which supplies the turbines. In this way a constant pressure is secured, regardless of the variations in the main stream. The turbine conduit is formed of tubes of sheet steel in sections 18 to 22 feet long and 3 feet internal diameter. It is laid along the ground to a distance of 1,350 feet. Branching from it is an overflow conduit which is underground and built in armed cement, of circular section, 26 inches in diameter. In the generating station on the bank of the stream are six Escher-Wyss turbines of 400 horse power and 600 revolutions; they have governors to regulate within 5 per cent, and give 75 to 80 per cent efficiency. The turbines drive six dynamos, including four Westinghouse three-phase alternators, used for the light and power system, and two direct current Thury dynamos for the electric railway. The machines are directly connected to the turbines. The new electric railway passes through Bex, Gryon and Villars, and is divided into three sections, according to the grade. The middle section has a steep grade and requires the rack-and-pinion system. The end sections use the ordinary rails. The road starts from the Jura-Simplon station, near Bex, and the first section ends at Salines de Bevieux, a distance of 11,000 feet. Here the rack-and-pinion begins, and mounts for 16,900 feet from Bevieux (altitude, 1,470 feet) to Gryon (altitude, 3,840 feet). The end section in ordinary rail continues for 14,500 feet to the hotels of Villars, 410 feet above Gryon. The trolley system is used, at 600 volts. At present the road uses four cars of the tramway type, two larger cars for the express service, and two locomotives for the rack-and-pinion section, besides the baggage cars. The electric locomotives have their equipment furnished by the Geneva Electric Company. The cost of the railway, including the rolling stock, amounts to $280,000.

## IMPORTANT COMPETITIVE TEST OF HIGH-EXPLOSIVE SHELL AT SANDY HOOK.

In all the history of proving ground trials there has probably never occurred one of such vital importance and sensational results as that recently concluded at Sandy Hook Proving Grounds, when two large-caliber, breech-loading, rifles each fired three shells, containing high explosive, at two face-hardened armor plates, with a view to determining the best method of attacking such plate with projectiles loaded with high explosive.

The two plates were identical. They measured 16 feet long by 7½ feet high by 11½ inches in thickness. They were manufactured under the Krupp patents, and represented the very highest class of armor plate produced in the world to-day, the body of the plate being extremely tough and the face of such hardness that a fragment of it will cut glass. The plates were set up against a framework of steel plating which was an exact reproduction of a section of the side of the battleship "Iowa." Immediately behind the plate was 6 inches of oak backing, then a ⅝-inch steel plate, which was in turn supported by four vertical plate frames of the same thickness and depth of those which back up the belt of armor at the waterline of the "Iowa." Behind these frames was another plate, answering to the interior skin of the ship. Back of this inner plate were four vertical 14 by 14-inch oak posts set up on four 14 by 14 longitudinals and strongly braced by diagonal struts of the same dimensions. A backing of sand was filled in to the rear to the full height of the target, completely burying the oak struts and sloping rearwardly for 40 or 50 feet.

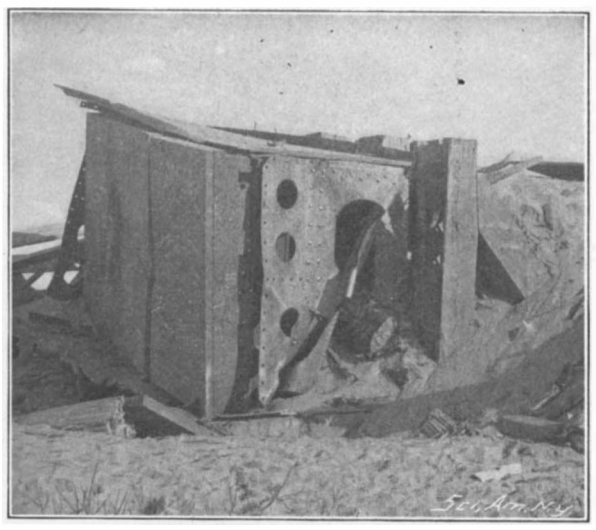
It should be explained that although the target as thus constructed was intended to represent the side of a battleship, and did so, as far as the depth and construction of the steel framework is concerned, the actual ability of the backing to resist displacement bodily to the rear, or in a vertical or horizontal direction, was nothing like as great as that of a plate when in place on a ship and receiving reinforcement from the adjoining framing and armor plating of the vessel. While the trial target afforded a reliable test of the penetrative power of the projectile for disruptive effect upon the plate itself, and upon the plate-steel backing behind it, it did not present a fair test of the resistance of the side of a battleship to what is known as the "racking" effect, or the tendency of the energy of the shell to crush the plate bodily into the side of the ship. This is a point which must be carefully borne in mind in estimating the value of the late trials.

Two distinct and, in some respects, diametrically opposite systems of using high explosives against a warship were tested. One of these was a torpedo shell designed by a civilian, Mr. Gathmann; the other system was represented by two high-explosive shells, one the invention of Hudson Maxim and the other invented by Capt. B. W. Dunn, of the United States army. The Gathmann system is based upon the theory that if a heavy charge of guncotton can be detonated against or near the outside of a battleship the detonation will have sufficient force to crush in the sides or deck of the ship, as the case might be. For some years army and navy experts have asserted that the mere detonation of a high explosive at the face of a plate produces no serious effect upon the plate itself. Mr. Gathmann and his associates, however, have secured various appropriations from Congress for the carrying out of full-sized tests with projectiles loaded with guncotton. The latest of these appropriations was for the construction of an 18-inch gun capable of throwing an 1,800-pound projectile, carrying 500 pounds of wet guncotton. The weapon was constructed at the Bethlehem Steel Works, and at the recent trials was given every opportunity to demonstrate the theories of its inventor.

The special type of gun constructed for the discharge of the Gathmann shell—which, by the way, in its present form is a very different affair from the original shell with which he commenced his experiments—is a huge piece, 44 feet in length, 59.6 tons in weight and having the unprecedented caliber of 18 inches. For a modern rifle, the muzzle velocity is low, being only 2,100 feet per second, it being constructed on the assumption that the penetration of the plate is not aimed at, but merely the delivery of a large amount of guncotton at its face, at a fairly high velocity. The chamber pressure in the gun is, therefore, low, being but 20,000 pounds to the square inch, as against 35,000 pounds as allowed in our latest navy guns. Hence, for the great caliber of the weapon it is certainly extremely feeble. A shell commensurate with the bore, if the gun were constructed on the principles adopted by our army and navy, should weigh nearly 3,500 pounds and present an energy of about 100,000 foot-tons at the muzzle. Or, if it were used with the latest velocities of 3,000 feet per second and over, the striking energy would be something like 200,000 foot-tons. In spite of its low velocity, however, the striking energy of the Gathmann shell in the last of the three rounds fired during these experiments rose to 52,000 foot-tons, which is 6,000 foot-tons greater than the calculated muzzle-energy of the new high-power navy gun, and is only exceeded by the 17-inch Armstrong breech-loading gun of 104 tons weight carried by some of the Italian battleships, and by the 110½-ton 16¼-inch guns mounted on the British battleships "Benbow" and "Sans Pareil," which have a muzzle-energy respectively of 55,000 and 54,000 foot-tons.

We draw special attention to the fact of the great striking energy of the Gathmann shell, because of its important bearing on the results as shown upon the target.

The first shot struck the target in the center of the plate with a velocity of 1,660 feet per second. A partial detonation took place; but the shell failed to make any impression upon the plate, other than that which would be expected from the striking energy of a shell of its weight. The point penetrated to a depth of about 1¼ inches, and the surface of the plate simply showed the customary splash resulting from the bursting of a shell upon the surface of armor plate. The second shot struck the target with a velocity of 1,660 feet and detonated more fully, but also failed to destroy the integrity of the plate, which was neither penetrated nor cracked. This shot, however, was fired toward the right-hand edge of the plate, and there being no contiguous backing, as there would be in the case of the same plate forming part of a waterline belt of a battleship, the plate was forced bodily into the backing, the rearward displacement being 35 inches at the right and 12 inches at the left. The third shot, with a velocity of 2100 foot-seconds, struck toward the left-hand edge of the plate, and evidently there was complete detonation. The striking energy of the shell (52,000 foot-tons) coupled with the enormous force of the detonating guncotton, forced the whole structure (plate, backing, timber



SIDE VIEW SHOWING CRUSHING EFFECT OF GATHMANN SHELL ON PLATE STEEL BACKING.

struts and the backing of sand, weighing in all some 700 tons) 8 feet to the rear and 8 feet to the left, so that the right-hand edge of the plate was now exactly opposite the center of the railroad track, the movement being shown in the two views on our front page. The transverse bending stress, due to the application of this force at one end of the plate, broke it in two, as shown in the photograph. That this transverse stress broke the plate is proved by the fact that the fracture took place, not at the point of impact of the third shot, but toward the opposite end of the plate. As in the case of the other three shots, the detonation of the 500 pounds of wet guncotton left practically but little evidence upon the plate itself at the point of impact.

After a long series of trials the ordnance officers at Sandy Hook have adopted two most remarkable high explosives, one maximite, and the other known officially as dunnite or high-explosive "D," which the Board was enabled to test by firing in the armor-piercing shot and shell which were used against the other 11½-inch Krupp plate. It is no exaggeration to say that the phenomenal success attending the 12-inch projectiles is one of the most sensational and epoch-marking events in the history of modern ordnance. For years artillerists the world over have been endeavoring to find a high explosive which would be sufficiently insensitive to bear the shock of being carried through armor plate, and also to find a delay-action fuse which would detonate this explosive the instant the shell had passed through the armor plate and was well within the ship or fortification, as the case might be. The melenite of the French and the lyddite of the English, of which we have heard so much in recent years, are high explosives which have been fired successfully in shells, but have failed to show the necessary insensitiveness to enable them to be carried through armor. In the trials of lyddite against the old armored battleship "Belleisle," the 6-inch shells fired by the "Majestic" splashed harmlessly upon the soft armor plate which that vessel carried, although when they passed through the unprotected ship's plating they burst with enormously destructive effect. For many years past, and particularly during the past eighteen months, the Ordnance Department of the army has been giving particular attention to the question of a high-explosive shell-filler, and in the months immediately preceding this test the experiments led up, by a process of gradual exclusion, to the choice of maximite and explosive "D" as the only two high explosives fully answering the requirements. That they answer these requirements was shown, even beyond the most sanguine expectations, in the competitive tests against the Gathmann gun.

On the first round a 1000-pound armor-piercing shot, filled with about 20 pounds of explosive "D," struck the plate in the center and exploded as it passed through. The bursting of the filler tore a conical-shaped hole through the latter half of the plate, and the fragments of plate and shell swept through the steel backing, cutting the oak struts in two and blowing a large cavity out of the sand backing. The second projectile was an armor-piercing shell loaded with 25 pounds of maximite. It struck the target toward the right-hand edge, penetrated and burst in passing through, and further demolished the backing. It completely wrecked the plate, cracking it entirely through, both vertically and horizontally, and blowing away an additional portion of the sand heap behind. The first two shots were fired with a velocity of 1,800 feet per second. For the third round it was resolved to take an ordinary armor-piercing shell, with relatively large cavity and thin walls, designed for a maximum penetration through 7 inches of ordinary nickel-steel, load it with about 65 pounds of explosive "D," and fire it against the 11½-inch Kruppized plate. Under ordinary circumstances, that is to say, if filled with a charge of ordinary explosive, the shell would be absolutely helpless against such a plate. This shell struck the target toward its left-hand side with a velocity of 2000 foot-seconds, and, exploding in the plate, tore out a section which was three feet across in its largest diameter and swept it with its own fragments and the fragments of the backing entirely through the great sand heap behind, finally landing the broken section of the plate, which weighed over a ton and a half, some 200 feet to the rear of the target. After a personal inspection of this target, or rather what was left of it, we felt satisfied that in a duel, at point-blank range, a vessel armed with these high-explosive armor-piercing shells, would have her opponent completely at her mercy. Any one of these shells bursting within a barbette would kill every man within it, and if it burst within a central rapid-fire battery, it would unquestionably paralyze the gun detachments, if it did not disable every gun within the battery.

### Compressed Air and Its Application.

Under the above title, Mr. Gardner D. Hiscox, M.E., has produced one of the most satisfactory technical books we have seen. Compressed air is gaining in popularity every day, yet the paucity of the literature on the subject is most remarkable. The author has spent much of his life as a specialist in compressed air and can, therefore, fully claim to be an expert, and the present volume substantiates this claim. The subject is dealt with in a comprehensive manner, no phase of it being omitted. He gathers from proceedings of societies and periodical literature the tables, some forty in number, which facilitate to a great degree the labor of the engineer or the foreman. This fund of information is of the utmost value, and on these tables rests, to a considerable extent, the application of compressed air for doing mechanical work. Mr. Hiscox opens his book with a historical summary. He then treats of the physical properties of air, air pressures below atmospheric pressures (dealing with drying and evaporating in vacuo, etc.), the flow of air under pressure, the power of the wind and thermodynamics. This brings us to the actual problem of compression, which is well handled by clear and concise chapters, dealing with all types of compressors and reheaters. The compressed air motor, pneumatic tools and hoists are then taken up, followed by chapters on compressed air in railway service, including the air-brakes; the use of compressed air by divers; the sand blast; the use of air for dusting and cleaning, in metallurgy, the air-lock system in caisson sinking and the pneumatic system of tube transmission, pneumatic guns, air and water lifts, refrigeration; the hygiene of compressed air and liquid air. The book is concluded by a digested list of all patents issued between 1875 and July 1, 1901. There are 822 pages and 545 illustrations in this handsomely printed volume.

The French and British telegraphic administrations have just established direct telegraphic communication between Paris and Liverpool. The new service was recently opened, and is sure to greatly facilitate correspondence between the two centers.

## New Underground Electric Railroads for London.

BY OUR LONDON CORRESPONDENT.

The congested traffic of the streets of London has become so acute, and the provision of more rapid transit from one point of the metropolis to another so imperative, that the matter has received the earnest attention of both Parliament and the London County Council, the latter of which is responsible for the well-being of the city. The success of the Central London and South London subterranean tube railways, which were purely tentative efforts to supply more expeditious traveling throughout the metropolis, has become so well established that similar means of communication are being projected in all directions. At the present moment there are over $250,000,000 at stake in connection with various enterprises of this description. Indeed, the schemes were so numerous that the government appointed a special Joint Committee of the two Houses of Parliament to investigate the respective plans. This committee has now issued its report upon the ten projects that it has considered; the best routes they should follow, and the main principles upon which they should be worked. The new tubes thus sanctioned cover 50 miles, and in view of the immense amount of money that is involved in their construction, it is essential that they should be closely studied from a public point of view, so that they may serve the interests of the community at large to the fullest extent, and also to avoid mistakes which would be irreparable in the future. The peculiar conditions of London traffic and the many difficulties that have either to be surmounted or circumvented, render this an abstruse problem to solve.

The committee, although mainly approving of the proposed lines in general, has stipulated several recommendations, which will have to be embodied. It has prevented the intrusion of one route upon another, although at the same time preventing any line from profiting by its practical monopoly at the expense of the public.

Probably the most important of these railways is that which will run parallel with the Central London Railway. It will start from Kensington, and extend to Piccadilly Circus, thence along the Strand and Fleet Street to the City. This line will tap the busiest thoroughfares and greatest commercial centers in the metropolis, and it should prove of inestimable benefit to the streets under which it will pass. The committee approves of the proposed Charing Cross-Hampstead line which Mr Yerkes is controlling, with a branch to Highgate, and another from Euston to Gospel Oak, provided there are no confluent junctions; also the Islington-Euston tube, connecting the former with the Islington branch of the City and South London Electric Railway, and the West and South London line, which will join Paddington to Victoria and thence run to Kensington, crossing the Thames at Vauxhall.

In the case of the King's Road tube it suggests that it be extended from Eel Brook Common to Putney Bridge. This line will run from the former station to Victoria, via King's Road, Chelsea. Interchange stations with the present trunk railways at Victoria are advocated. The North-East London tube, as proposed, begins at Cannon Street, and runs via Gracechurch and Bishopsgate Streets out to Tottenham, a thickly populated and at present badly served suburb, with a branch at Stoke Newington to Walthamstow. The City and North-East Suburban Railway has a proposed route from Bishopsgate Street to Waltham Abbey. This line would run through four miles of tube and ten miles of open country. At the city end of this tube the committee advises that it should run through Leadenhall Street and thus tap populous Whitechapel. If the Waltham Abbey Line be carried out, there will be no need for the North-East London branch to Walthamstow. The North-East London main line to Tottenham should be extended to where the London County Council are erecting workmen's dwellings.

The Charing Cross, Hammersmith, and District tube would run as proposed from Hammersmith through Kensington to Hyde Park Corner, whence it would cross the Green Park to Charing Cross. Here it is proposed to connect with the Piccadilly-City tube, running from Piccadilly Circus to Cannon Street, where it joins the North-East London system.

The great Eastern Trunk Railroad to the Eastern Counties, which also serves several of the most thickly populated eastern suburbs, also proposes to construct a tube from its city terminus at Liverpool to Ilford, as an effective means of relieving its trunk lines of the greater part of its present congested local traffic. This railroad carries over 1,000,000 passengers between the city and these particular suburbs every night and morning, so that the paramount importance of the scheme will be adequately realized.

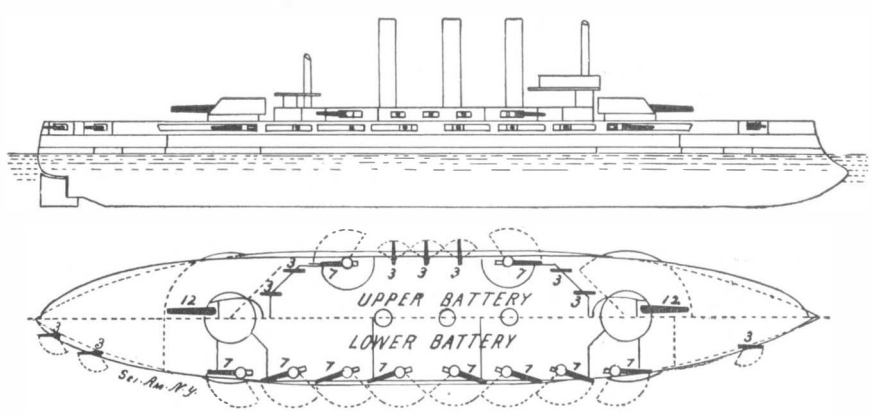
Electric traction is to be used on all these tubes, and the most economical system is to be adopted. The companies themselves will probably take care to observe this fact upon their own initiative, since the question of fares is controlled by legislation, which in this respect is favorable to the community. Once a railroad in England has established its maximum fare, it cannot raise it, even if it proves unprofitable, without the consent of the government; and if the latter considers that the existing tariff of any particular railroad is too high, then steps are immediately taken to compel that railroad to reduce its rates. The railways should be run for the benefit of the community is the axiom of Parliament. The Joint Committee, in dealing with the fares, recommends that this should be dealt with by the Board of Trade, which department supervises this question, but at the same time it advises that the Board of Trade should every five years report on the reasonableness of the fares and on the relations of the companies toward one another. Care is also to be observed that the companies are not over-capitalized. The lines must be constructed beneath the streets, since, the latter being public property, no heavy compensation will have to be paid, which would otherwise be the case if the privileges of burrowing beneath private property were sought. It also recommends that they should be either partially, or entirely, municipalized, as by this means the construction of railways in thickly populated or the development of unopened districts will be encouraged.

Tubes may be worked at the termini on the shuttle system (i. e., by trains shunting from the down line onto the up line) or by means of terminal loops, which would avoid shunting. Confluent junctions (i. e., trains running from one set of lines onto another at points) are to be avoided inside tubes.

The development of underground railroads has hitherto been severely handicapped by legislation. But the government has now awakened to the fact that this method of transit offers the only practical solution to the relief of the congested character of the streets. It is therefore suggested by the Joint Committee that a special supervising body should be constituted to control the construction of the present schemes, their working, and the regulation of projected tubes that will arise from time to time. By this means, the indiscriminate construction of tubes in all directions, and inconvenient overlapping, will be avoided. Such a public supervisory board would also insure that the convenience of the community was fulfilled to the fullest extent. It is contended that every new line should be part of a well-considered system, the essential point of which must be to make travel easy from one point of Greater London to any other.

If the task is threshed out now, it will be easy enough; if it is neglected, vested interests and the competition of lines covering the same districts will make it very difficult in the future. The matter is important enough to justify the appointment of a special Board of Control for underground lines, with representation of Central London and of the various localities interested.

The majority of these tubes will be laid at a depth of 60 feet below the streets. The London County Council favors, in certain cases, the construction of shallow tunnels similar to the rapid transit tunnel of New York. This will serve a dual purpose. Elevators from the street level to the buried tubes will be obviated, since if a tunnel were laid immediately below the surface of the thoroughfare, steps only would be necessary. Another important factor in connection with shallow tunnels is that all telephone and telegraph wires, water pipes, sewers, cables, etc., would be laid in adjacent tunnels, so that to repair or to overhaul them it would be unnecessary to break the surface of the ground, which procedure severely interrupts pedestrian and vehicular traffic. There is no doubt that this principle of intercommunication, so far as the actual city itself is concerned, will be adopted, as several of the members of the London County Council have visited this city, studied the rapid transit tunnel scheme and reported favorably thereon. London is undergoing a radical revolution in connection with its traffic, and it remains to be seen whether the most beneficial advantages will be taken in connection with its fulfillment.




**BOARD ON CONSTRUCTION MAJORITY DESIGN FOR NEW 15,560-TON BATTLESHIPS.**

Main Battery: Four 12-inch, twenty 7-inch. Secondary Battery: Twenty 3-inch.

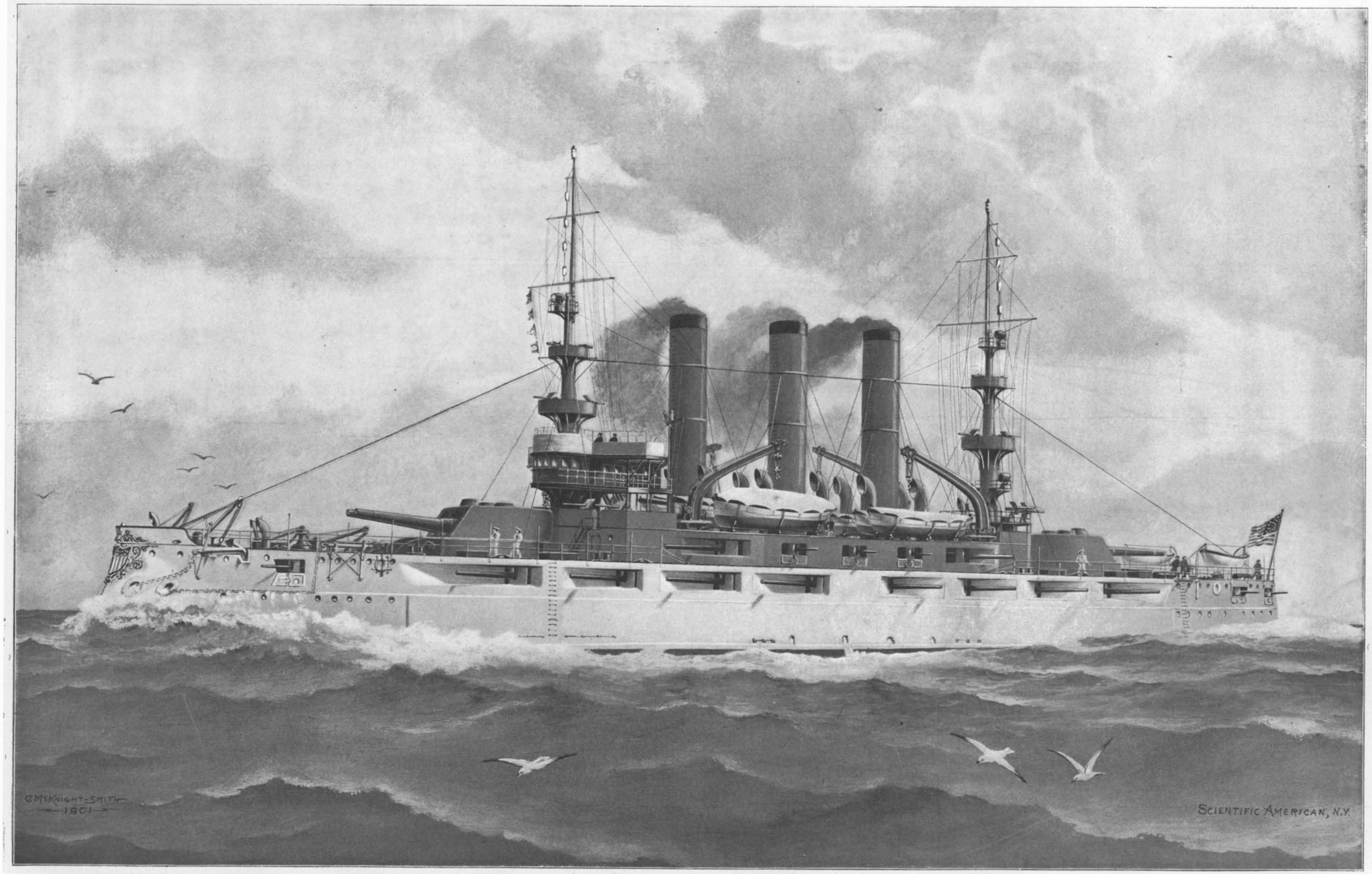
## OUR LATEST DESIGN FOR BATTLESHIPS.

On the adjoining page is an illustration of the most powerful battleship ever designed in the history of naval warfare. The term powerful is used in its broadest sense as applying both to offensive and defensive qualities, and those other subsidiary but scarcely less valuable elements of speed, radius of action and habitability. There is probably no branch of engineering construction in which there is less of what we might call exclusive national individuality than in the matter of warship design; and just as in the yacht races held last summer off Sandy Hook it was seen that the two national types had approximated so closely that it required an expert to distinguish the British from the American yacht, and the speed was so close that in two out of three races sailed, the event was won by seconds only, so in warship design, the various nations keep in such close touch with each others' developments that the modern warship, no matter what flag it flies, approximates closely to a common type.

The Naval Board on Construction, by whom the new battleship herewith illustrated was designed, is composed of five Chiefs of Bureaus, the Bureaus being those of Construction, Ordnance, Engineering, Supplies and Intelligence. It is evident that of these five gentlemen the first three, being what might be called the technical members of the Board, would be naturally considered the most qualified to speak on the question of warship construction, since the Construction Department is responsible for the hulls, the Steam Engineering Department for the motive power, and the Ordnance Bureau for the guns, and this is said without any reflection upon the other two members of the Board, whose long experience on sea duty is, of course, of unquestionable value. As bearing upon what we have just said, it is significant that the three members of the Board representing the technical bureaus are strongly unanimous in recommending that our new battleships be constructed upon the plans herewith presented, the Chiefs of the Bureaus of Supplies and Intelligence voting in favor of a ship which differs mainly from the one shown by carrying its guns in double-decked turrets, and retaining the 8-inch guns as part of the armament.

The type adopted by the Board abolishes the 8-inch gun, abolishes the double-decked turrets, abolishes the 6-inch gun and reduces the number of types of weapons to three—the 12-inch, the 7-inch and the 3-inch; the first-named being carried in turrets and the 7-inch and 3-inch in broadside armored casemates. The proposed ships are to be 450 feet in length, 76 feet in beam and on a mean draft of 24 feet 6 inches are to have a displacement of 15,560 tons, while at extreme draft they will displace 16,900 tons. Engines of 20,000 horse power are to be provided, consisting (if the Chief of the Bureau of Steam Engineering has his way) of three sets of triple-expansion engines driving three propellers. The armament will be made up of four 12-inch, twenty 7-inch, and twenty 3-inch guns. The 12-inch rifles will be carried in two turrets, one forward and one aft, protected by 10 inches of Krupp armor. On the gun deck there will be sixteen of the new type 7-inch rapid-fire guns, protected by a continuous wall of 7-inch armor, this 7-inch armor extending down to the top of the main armor belt, which latter reaches continuously from stem to stern at the water line. On the main deck within at the four corners of the superstructure will be four other 7-inch guns, each of which will be contained in a closed casemate protected by 7 inches of armor in front and 2½ inches of armor at the rear. Of the sixteen 7-inch guns on the gun deck, the two forward and two after pairs will be each emplaced within a casemate protected with 7-inch armor, while the other twelve guns on this deck will be carried within a central citadel similarly protected, which will be divided transversely by two walls of 2½-inch armor extending across the gun deck between each pair of guns. These transverse walls will serve to limit the destructive effect of a shell which might penetrate and burst within the casemate.

In addition to this numerous and extremely powerful battery there will be twenty of the very effective 50-caliber 3-inch guns, a type which has recently been perfected by the Bureau of Ordnance. Of these, six will be carried on the main deck, two forward in the bow and four astern, each gun being protected by 2 inches of Krupp steel. On the main deck there will be fourteen more of these weapons, six of them being carried in broadside between the 7-inch guns and the other eight being carried at the ends of the superstructure and having a range of fire from abeam to




**MAJORITY DESIGN FOR NEW BATTLESHIPS.**

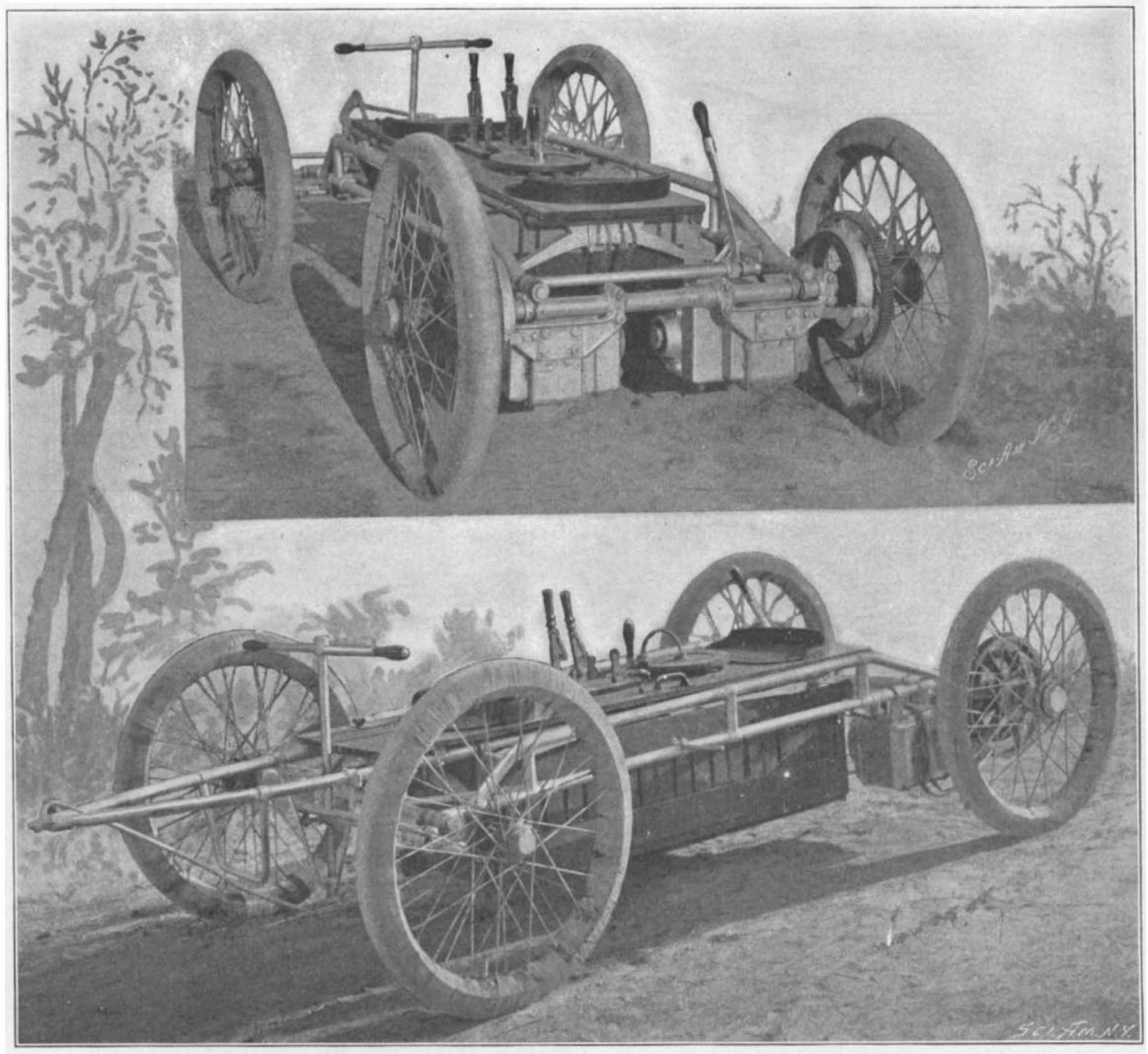
**Displacement,** 15,560 tons. **Speed,** 19 knots. **Maximum Coal Supply,** 2,000 tons. **Armor:** Belt, 10-inch; Barbettes and Turrets, 10-inch; Casemates, 7-inch. **Armament:** Four 40-caliber, 12-inch; twenty 50-caliber, 7-inch; twenty 50-caliber 3-inch

dead-ahead and dead-astern. The concentration of fire ahead from this arrangement of battery will be two 12-inch, four 7-inch and six 3-inch, while astern it will be possible to concentrate two 12-inch, four 7-inch and eight 3-inch guns. On each broadside there will be a concentration of four 12-inch, ten 7-inch and ten 3-inch guns.

The design marks a return to the "Alabama" and "Maine" type, than which we are inclined to think none better was ever thought out for our own or any other navy. It has the advantage of simplicity, of reduction of the number of different types of guns and of an excellent distribution of their emplacements. Having the 12-inch gun for the penetration of turrets, barbettes and belt armor, the 7-inch heavy enough to penetrate 6 and 7-inch casemate armor, which is something more than the 6-inch gun is capable of doing, and the 3-inch gun, which with its high velocity and great speed of fire will be used for smothering the gun ports and unprotected gun positions of the enemy with a storm of shells, and riddling smoke-stacks, superstructures and unprotected shell plating, the attacking power of the vessel will be both enormously powerful and well distributed. With the exception of the 12-inch guns, each piece has its own separate traversing and elevating gear, and although the protection is not, perhaps, quite so absolute as that afforded by turrets, this is more than offset by the fact that the gun crew can see where they are and what they are doing, a most important consideration as affecting the morale of the men in battle. There is, in a comparison with 8-inch guns carried in turrets, the inestimable advantage that each 7-inch gun, being separately mounted, is not disturbed by the discharge of adjoining pieces—this last defect being one of the chief objections to the mounting—as in the superposed turret—of four guns upon a single turntable.

The advocates of the minority design favor the double turret, we understand, more for the sake of the larger piece (8-inch) which it carries than for any particular regard for the turret itself. Might it not be possible to compromise on the two plans by adopting the disposition of guns shown in the majority report, and substituting, say, sixteen 8-inch for the twenty 7-inch rifles? To secure the all-around protection afforded by the turret it would only be necessary to place transverse screens of armor between every gun on the gun deck and work continuous longitudinal screens from forward to after bulkhead, thus placing each 8-inch gun in a separate, completely boxed-in, casemate. In any case, whether the 7-inch or the 8-inch battery be used, it seems to us that in view of recent developments in high-explosive shells it would be wise to isolate entirely each gun by the addition of the transverse and longitudinal armor screens above suggested. We understand that the Board is likely to compromise on some such plan.

This fine battleship was not reserved for our special number on the "Development of the U. S. Navy Since the Spanish War," Dec. 14, 1901, for the reason that the issue will contain only the ships that have been either commissioned, commenced or authorized since the war. Although Congress has authorized the drawing up of the plans for these battleships, no money has yet been voted for their construction, and hence they must necessarily be shut out of any tabulation of our navy that is drawn up on the basis we have chosen. Rather than omit mention of these fine ships altogether we present the above description.



RIKER ELECTRIC RACING AUTOMOBILE WHICH MADE THE PHENOMENAL RECORD OF ONE MILE IN 63 SECONDS ON SATURDAY, NOVEMBER 16TH.

## NEW AUTOMOBILE SPEED RECORDS

Twenty-five thousand persons lined Ocean Parkway, Brooklyn, for a distance of two and a half miles on Saturday, Nov. 16th, and saw the most sensational automobile one mile speed tests ever made on either side of the Atlantic. A mile a minute on the highway is no longer an automobile dream; for no less than three of the contestants finished within that time. Fournier, the winner of the Paris-Berlin race, twice broke the world's record, and was closely followed by Foxhall P. Keene, A. C. Bostwick and A. L. Riker. The course was a specially prepared dirt strip of the old Coney Island Boulevard, having a slight down grade. The contestants went over the course singly, their times being taken at the start and at the finish by members of the Second Signal Corps, U. S. A. Over a mile was allowed to the chauffeurs to get under way, and about a quarter of a mile to slow up after passing the finish line. The race was a contest by some of the best chauffeurs in the world for the one-mile record.

At his first attempt Fournier, in his 40 horse power Mors racer, sped over the mile in the remarkable time of 52 seconds. Not content with this performance, he returned to the start for another trial, and succeeded in reducing the record made but a few minutes before by one-fifth of a second. Foxhall P. Keene, in a Mors carriage exactly similar to that of Fournier, covered the mile in 54 seconds. American-built vehicles were not much behindhand. A. C. Bostwick, in a 40 horse power Winton gasoline carriage, made the mile in 56 2-5 seconds at the first trial, and in 1 minute 3-5 seconds at the second trial.

Good as the road undoubtedly was, it was not altogether free from slight, almost unnoticeable depressions and projections. At a speed of twenty miles or even thirty miles an hour an automobile will ride over a slight elevation with no appreciable effect. But at the enormous velocity of nearly seventy miles an hour the carriages could not yield to the slight, scarcely-perceptible hollows, and at times every wheel would be clear of the road. And yet, despite this peculiar effect, they kept their course with remarkable precision and with no evident oscillation.

The vehicles driven by Fournier and Keene were both 40 horse power French gasoline carriages made by Mors. That a gasoline carriage would make the best record was inevitable. But no one foresaw that an electric car would also lower the previous world's record of 1 minute 6 2-5 seconds made by Winton. The carriage in question was designed and driven by Mr. A. L. Riker, and was a distinctly American type of machine. It was a racing machine pure and simple, an electromobile reduced to its lowest terms, a wheeled frame and a battery, with seats for two men arranged in tandem. Current is derived from 60 cells of the lead-zinc type, giving a maximum voltage of 130 and a discharge of 100 amperes. The battery weighs 900 pounds, and the entire carriage 1,850 pounds. With a start of only one-quarter of a mile, Mr. Riker covered the mile in 1 minute and 3 seconds, the armatures of his motors making about 3,300 revolutions per minute. The exact power of the vehicle has not been determined; but Mr. Riker informs us that the horse power is between 15 and 20. When it is considered that the French carriages of Fournier and Keene were equipped with motors rated at 40 horse power, Mr. Riker's performance is all the more remarkable. At the same time it is but just to the other vehicles to state that while they were all capable of long-distance touring, the electric machine was capable of maintaining its maximum effort apparently for only a single dash over the mile course. It was towed to the course, towed back to the starting point after its trial, and charged its batteries immediately before its trial run from an adjoining electric car. By a special rheostat with which he has fitted his racing machine, Mr. Riker is enabled to divert part of the current from the field coils to the armature, after speeding up, so that the rotary speed of the armature-shaft is considerably increased. Since the racing machines of Fournier and Keene have already been illustrated in these columns, we have pictured only the carriage used by Mr. Riker.

The arrangements for timing the contestants seem to have been somewhat unusual. The timers at the finish were informed by the click of a telegraph instrument that a machine had started. An instant later an "O. K." signal was given to confirm the start. The timers consequently started their watches with the first click and caught the machines as they whirled past the finish line. If no "O. K." signal were given the watches were turned back for the next signal. As a result of this arrangement some machines ran over the course without being timed, no additional signal having been given. Foxhall P. Keene was one of those who suffered. His first trial was credited with a speed of 1 minute and 21 2-5 seconds, which was clearly an error. S. T. Davis, who made the mile in 1 minute and 15 seconds in a steam carriage and thus broke the previous steam carriage record of 1 minute and 39 seconds, was also mistimed in one of his attempts.

These are the most remarkable contests ever run on a public highway. They have shown that only a specially built locomotive engine running on steel rails can beat a modern racing automobile.

It is authoritatively stated that a concession has been granted by the government of Mexico to an American syndicate, to build a railroad from Monterey to Matamoros, which is situated in the State of Tamaulipas, near the mouth of the Rio Grande. The concession carries a governmental subvention of $8,000 a kilometer (0.62137 mile), and there is a strong probability that the State of Tamaulipas will add $2,000 a kilometer to this amount. The rich resources of northern Tamaulipas have remained undeveloped up to the present, on account of inadequate transportation facilities. Almost anything suited to a subtropical climate will grow in this section, especially corn, cotton, fruits, vegetables, sugar cane, etc., and it has recently been demonstrated that rice can be successfully cultivated near the Rio Grande. The extent of land lying along the rivers and through which the proposed railroad will pass, which is susceptible of successful irrigation, is unlimited. Mexico, and especially the State of Tamaulipas, offers inducements to prospective investors and capitalists, and the policy of both the national and State governments is to judiciously protect whatever industries may be established.

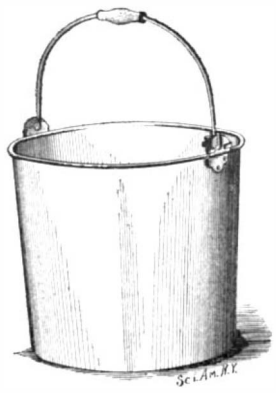
### The Current Supplement.

The current SUPPLEMENT, No. 1352, has a number of articles of more than usual interest. The front page and two succeeding pages are given up to "Wire Grass—A New Industry," in which all the steps in the process of wire grass cutting and utilization are outlined. This is a comparatively new material and is proving of great value. The fourth installment of the important series of "Enameling" is published in this issue. "A Comparison of the Merchant Fleets of the World" shows graphically the relative size of the merchant marine of the twelve leading nations. "Comparison of Recent Battleship Designs" occupies considerable space. "The Geographical Conquests of the Nineteenth Century," by Gilbert H. Grosvenor, is accompanied by maps of various continents.

# Patent Department

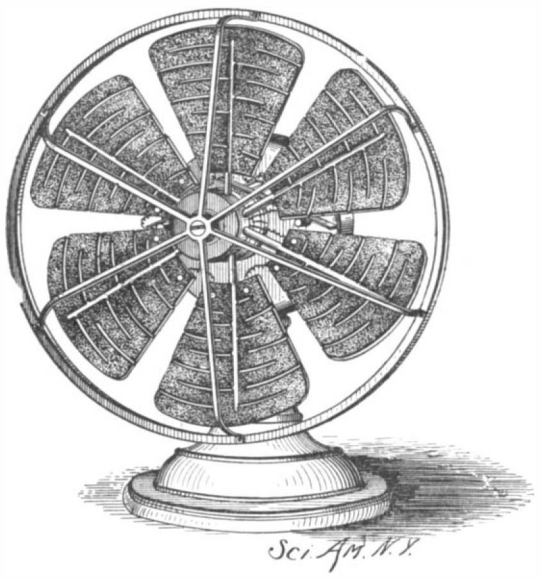
### ODD CONTRIVANCES.

BAIL SUPPORTER.—A kettle bail that will never stand in the position in which it is placed, is one of the petty annoyances to which every housewife is subjected. A Western inventor, Mr. Silas Baker, of Pawpaw, Ill., intends to do away with this old annoyance by means of a simple little device which is intended to hold the bail in such a position that it cannot rest against the kettle. To the ears of the kettle a semicircular piece of metal is secured, having a hole near its center and a flange on its circular edge. A series of notches in the edge of the flange engage and hold the wire bail. Lugs are employed to attach the semicircular piece of metal to the ears of the kettle.



ADJUSTABLE BAIL SUPPORTER.

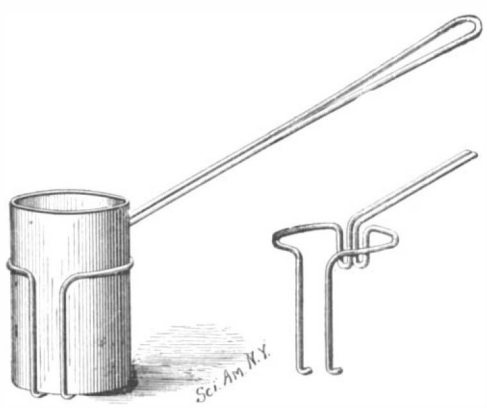
ELECTRIC HEATER.—A Boston inventor has conceived the idea of using a fan motor so that hot air can be supplied. He makes the blades of his fan of carbon, which has both the required mechanical strength for moving the air and also the electrical qualities necessary to form a heating resistance. The current is passed directly to the blades, dispensing with the complicated intermediate devices which have been heretofore employed. The invention avoids the use of blades supporting the usual resistance wires on insulating pins, skeleton frames supporting wire



ELECTRICAL FAN AND CARBON HEATER.

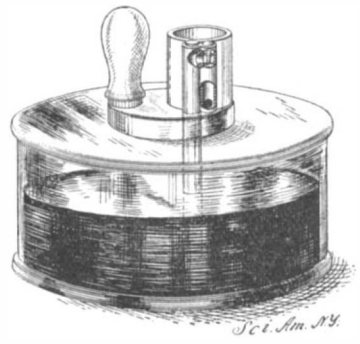
gauze which forms a heating resistance and other forms, comprising a resistance and a blade-supporting the resistance. In this device the blade which fans the air is itself the electrical heating resistance, and that seems to be a novel feature.

DIPPER-HANDLE.—A convenient form of handle for dippers, cans and other vessels, which can be as readily attached as it can be removed, is illustrated in the annexed engraving. The handle is made of a single piece of wire, so bent as to provide a support for the bottom, and to embrace the vessel. Our illustration so clearly shows the peculiar construction of the handle that an extended description is not necessary.

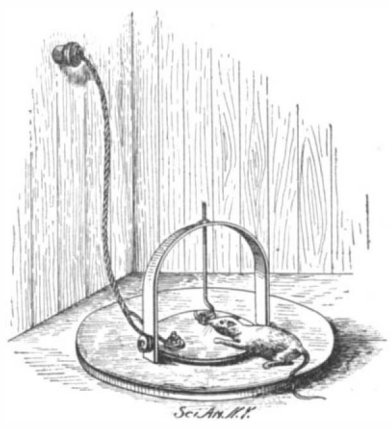


REMOVABLE DIPPER-HANDLE.

SIPHON INKWELL.—In order to prevent the exposure and consequent evaporation of ink, inkwells have been devised consisting of a large ink reservoir from which ink is supplied to a small dip-well. The ink is usually forced from the reservoir into the dip-well through a supply opening. As a result the ink is exposed, evaporates, and leaves a fixed deposit which not only renders the well unfit for use, but frequently clogs the supply opening and prevents the replenishing of the dip-well. The improved inkwell pictured is free from this defect. A siphon has its long leg extended into the reservoir and its short leg in communication with the bottom of the well. A port pierces the wall of the well above its bottom and communicates with the siphon at a point between its ends. A valve controls the port in order to complete the siphon and empty the well, or to break the siphon and establish communication with the well at an elevated point for the return fluid. By means of a rubber bulb air is forced into the reservoir above the ink, so that the ink, being subjected to pressure, will pass through the siphon and will escape into the well through the port. In order to retain the ink within the dip-well after releasing the bulb, an overflow port is provided piercing the short leg of the siphon and the wall of the dip-well at a distance to permit the retention of a proper amount of ink in the dip-well.

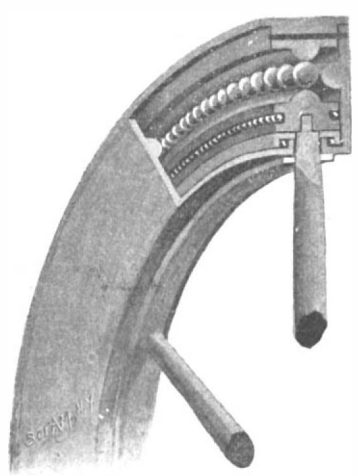


ELECTRICAL TRAP.—An inventor has conceived the idea of killing mice and rats by electricity, and has to that end devised an electrocuting-trap. The base of the trap is a conductor of electricity. Upon this base a conducting platform is placed, separated from the base by an insulating material. An arched bait-holder is electrically connected with the base. Wires leading from any convenient source of electricity are connected with the base and the superposed platform in open circuit. When the rat leaps upon the platform and snatches the bait, the circuit is closed and the entire current passes through its body.



ELECTRICAL MOUSE-TRAP.

BALL-BEARING WHEEL.—A ball-bearing wheel is a novelty for which Frederick P. Vaughan, of Perry, Oklahoma Territory, recently secured a United States patent. The wheel consists essentially of an inner portion provided with an inner bearing ring, and an outer bearing ring forming the tread of the wheel. The outer bearing ring is provided with sides interlocked with the inner portion of the wheel. The inner and outer bearing rings form a raceway for balls. The inventor states that the wheel reduces the friction to a minimum and is capable of sustaining heavy loads. Water is effectually excluded from the interior of the rim by reason of the peculiar construction of the interlocked inner and outer rings.



A BALL-BEARING WHEEL.

### Electric Burglars' Tools.

Sometimes we must turn to European papers to find out what our enterprising, inventive burglars have been doing in the way of devising more efficient means of "cracking safes." It seems that some time ago a burglar was caught in New York upon whose person a small electric lamp of the cylindrical type was found. The New York sensational journals naturally dilated upon the use of the electric light instead of the time-honored dark lantern. The London Daily Mail seized this story with avidity, and enlarged upon it until it finally assumed the following shape: "The New York police to-day arrested two thieves who had been committing extensive burglaries in wealthy suburban districts. One burglar carried an electric bludgeon operated by a storage battery and capable of shocking and stunning a person. He also had an electric saw and jimmy for opening safes. His companion carried an electric lamp instead of the old-fashioned oil-lantern. The two burglars were well-dressed and had good manners. They are said to be skillful mechanics. The police say that the electric bludgeon is one of the most dangerous weapons ever seen."

### Tesla's Recent Patents.

Nikola Tesla has received several patents for a "Method of Intensifying and Utilizing Effects Transmitted Through Natural Media." In one of his systems Tesla varies the potential point or region of the earth by imparting to it intermittent or alternating electrifications through one of the terminals of a suitable source of electrical disturbances which, to heighten the effect, has its other terminal connected with an insulated body, preferably of large surface and at an elevation. Electrifications communicated to the earth spread in all directions, reaching a circuit which generally has its terminals arranged and connected similarly to those of the transmitting source, and which operates upon a highly sensitive receiver. Another of Tesla's methods is based upon the fact that the atmospheric air, which behaves as an excellent insulator to currents generated by ordinary apparatus, becomes a conductor under the influence of currents or impulses of enormously high electromotive force. By such means air strata, which are easily accessible, are rendered available for the production of many desired effects at distances. Although either method may be employed, it is obviously desirable that the disturbance should be as powerful as possible and should be transmitted with a minimum loss. The loss reduces greatly both the intensity and the number of the co-operative impulses, and since the initial intensity of each of these is necessarily limited, only an insignificant amount of energy is thus available for a single operation of the receiver. Furthermore, the energy obtained through the co-operation of the impulses is in the form of an extremely rapid vibration and unsuitable for the operation of ordinary receivers. To overcome these limitations of the two methods mentioned, Tesla reproduces arbitrarily varied or intermittent disturbances or effects; transmits these disturbances through the air to a distant receiving station; utilizes the energy derived from such disturbances at the receiving station to charge a condenser; and uses the accumulated potential so obtained to operate a receiving device.

The apparatus which is employed at the receiving station consists in the combination of a storage device included in a circuit; connection points at a distance from the source of the disturbances and between which a difference of potential is created by such disturbances; a receiving circuit connected with the storage device; a receiver included in the receiving circuit, and a mechanism for closing the receiving circuit at any desired moment, thereby causing the receiver to be operated by the energy with which the storage device has been charged.

In another method the energy stored is not, as in the preceding instance, obtained from the energy of the disturbance effect transmitted from a distance, but from an independent source. The method in general consists in charging a storage device with energy from an independent source, controlling the charge of the device by the action of the effects or disturbances transmitted through the natural media, and coincidently using the stored energy for operating a receiver. A condenser is used as the storage means.

The invisible radiations of the spectrum and of vacuum tubes are generally considered to be vibrations of extremely small wave length. These radiations possess the property of charging and discharging conductors of electricity, the discharge being particularly noticeable when the conductor upon which the rays impinge is negatively electrified. It is usually held that these radiations ionize or render conducting the atmosphere through which they are propagated. Tesla's own experiments lead him, however, to conclusions more in accord with the theory he has already advanced, in which he holds that sources of such radiant energy throw off with great velocity minute particles of matter which are strongly electrified, and therefore capable of charging an electrical conductor, or, even if not so, of discharging an electrified conductor either by carrying off bodily its charge or otherwise. Tesla has taken out a patent based upon a discovery which he has made, that when rays or radiations of this kind are permitted to fall upon an insulated conducting body connected with one of the terminals of a condenser, while the other terminal is made by independent means to receive or carry away electricity, a current flows into the condenser so long as the insulated body is exposed to the rays. Under certain conditions an indefinite ac-

cumulation of electrical energy takes place. This energy after a suitable time interval, during which the rays are allowed to act, may manifest itself in a powerful discharge, which can be utilized for the operation or control of mechanical or electrical devices or rendered useful in many other ways. The radiant energy is directed upon an elevated conductor, connected with one of the armatures of the condenser, positively electrified by the invisible radiations. The electricity is carried off from the other armature by connecting it with the ground. The accumulated energy is discharged through a suitable receiver.

### Recent Improvements in the Nernst Lamp.

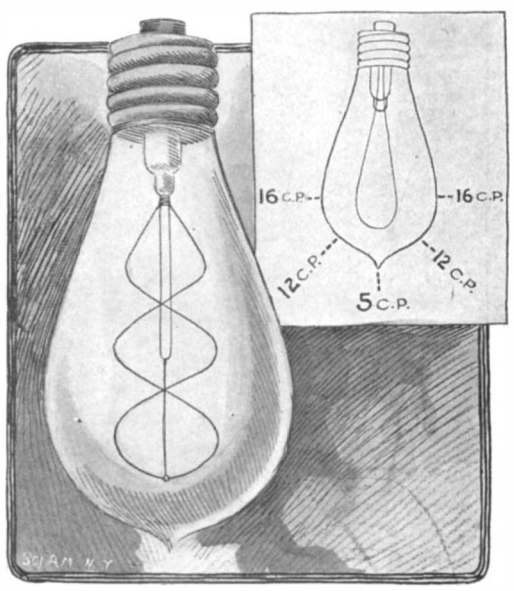
Several patents have recently been issued in the United States to Walther Nernst, Henry N. Potter, and Marshall W. Hanks, for processes and devices designed to overcome various defects which have been noticeable in the Nernst lamp.

Mr. Potter intends to use several spirals of wire to effect the heating of a single glower, or a number of glowers. A single spiral suffices to heat small glowers with sufficient uniformity, but when glowers of large-current capacity are to be started up, the heat must be very evenly distributed to prevent cracking of the glower. Instead of increasing the diameter and length of wire of a small heater, which is rather costly, Mr. Potter finds it cheaper to multiply heaters in parallel. Several heaters equal in surface to a single large heater, he finds, will heat up more quickly, as they have but a fraction of the mass of the large one. Several heaters can be so distributed about a glower that their combined effects heat much more evenly than a single spiral practically can.

The quality possessed by the glowers of acquiring an increased conductivity under the influence of heat has been counterbalanced by the employment of ballast-conductors placed in series with the glowers. But in the practical manufacture of standardized ballast and of glowers having uniform qualities under the conditions of practical use, it is sometimes found that an additional adjustment of the ballast is needed in order to secure perfect working. It is sometimes desirable to employ a ballast inclosed in an air-tight chamber, or so to construct the principal portion of the ballast that it is not readily adjustable. Mr. Nernst has devised a divided ballast, a portion of which is standardized as perfectly as possible, while the remainder is adjusted according to the peculiar conditions of each glower. By the employment of the divided ballast it is possible to compensate for any imperfection in the standardized ballast or in the glower, or both.

Mr. Nernst has likewise invented four compositions for glowers. These compositions consist essentially of the oxide of zirconium mixed with earths of the yttrium or cerium groups.

An effective and easily practised method for treating Nernst lamp glowers whereby they may be adapted to circuits of a given voltage, is the subject of the patent granted to Mr. Hanks. The adaptability




**THE IMPROVED FORM OF INCANDESCENT LAMP FILAMENT COMPARED WITH ONE OF THE "HAIRPIN" TYPE.**

of glowers to any given voltage is determined by length, cross section and composition; and it is generally the practice to make the glowers for use with circuits of any given voltage as nearly as possible of the same composition, the same diameter, and the same length. Despite the utmost care exercised in manufacture, more or less variation from the condition desired is likely to ensue. After the glowers have been completed it is obviously not feasible to change the composition or to decrease either the diameter or the length. Mr. Hanks therefore proposes to provide glowers which actually require higher voltages than those for which they were originally intended, with coatings of material, the composition of which is the same as that of the glower body itself. Assuming that the glowers to be treated are actually adapted for higher voltages than those for which they are desired, Mr. Hanks subjects them in a heated condition to a cloud of powdered material which is the same as that of the glower body itself. If the glower is treated while hot and is rotated during treatment, the powder will be deposited in a uniform layer. The treatment is continued until a voltmeter, connected across the circuit from which the energy for heating the glower is derived, indicates that the desired increase in cross-section has been obtained.

### THREE NEW ELECTRICAL DEVICES.

The matter of rating the efficiency of an electric lamp of the incandescent type is always difficult. for the reason that the glow is found to vary greatly when

**SPRING-ROLLER LAMP HANGER.**

the readings are taken at different points. Because of the variable distribution of the light rays, this form of illumination could never be regarded as entirely faultless. What is known as the "hairpin" filament, the first form ever used, varied but slightly in its illumination on the horizontal plane; but it was sadly deficient in its vertical distribution, a very small percentage of its maximum candle power being thrown directly down through the tip. The next step forward was the single loop, which had the effect of increasing the amount of light directed through the tip end of the bulb; but the vertical distribution was much more irregular than with the "hairpin" filament. Following these were the double filament, the anchored coil, and the double loop, but none of these reached the standard set. The latest addition to the assortment of bulbs on the market is one with a spiral filament, which is shown in the accompanying cut beside a "hairpin" filament. The spiral design is said to give the maximum candle power at every point on the vertical as well as the horizontal plane.

It is often necessary to shift the position of a hanging electric lamp. One man likes his light high, while another wants it as near the work as it can be placed. In offices and industrial establishments where one desk or workbench is used by different persons, many curious ways of making the change are brought into requisition.

A device by which this change is at all times readily accomplished is shown in the accompanying cut. The lamp is provided with about ten feet of flexible cord, and mounted on a spring roller which locks automatically at any desired point. By the aid of this arrangement, the lamp can be drawn up or down to any point, in much the same manner as a spring-curtain.

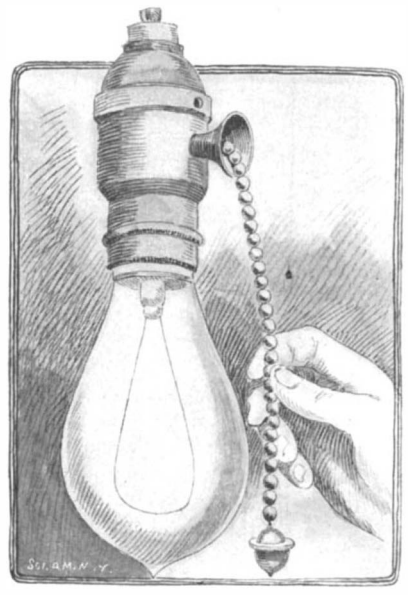
An electric light when hung quite high is necessarily wasteful, for the reason that it is a matter of considerable inconvenience to turn off the current. Of course in such instances a wall switch button may be used, but this entails more or less elaborate wiring and more expensive attachments in the lamp-socket. The thumbscrew with which most of the lamp-sockets are fitted at present is the most simple and economical arrangement which can be devised, and answers all purposes where the lamp is within easy reach. It is, however, inadequate where it is found necessary or desirable to hang the lamp beyond the ordinary reach, because in order to turn it off after use, it is necessary to secure a chair or ladder. Rather than do this the light would be allowed to remain in operation, running up needless charges for current. With the chain pull just brought out, this matter is solved in a very simple manner. The socket is supplied with a make-and-break attachment of the sliding kind, operated by means of a chain of any desirable length. One pull of this chain extinguishes the light and the next turns it on. This apparatus is said to be quite as convenient as the wall switch and, as stated above, much more economical.

### A Substitute for Rubber.

The young shoot of the Rocky Mountain greasewood plant has a milky sap, and the old wood a resinous gum, which is soluble in carbon disulphid and in other known hydrocarbon solvents of rubber. From the young greasewood sap two inventors have discovered a method of making artificial India rubber. The plant is bruised between rollers, whereby the bark is loosened and the woody fiber of the larger stems crushed. The entire mass is then inclosed in a vessel, mechanically agitated, and exposed to the action of carbon bisulphid, carbon disulphid, naphtha, or other solvent of India rubber. After exposure for some hours to the action of the solvent, heat being applied if necessary, the liquid is strained off. The liquid solvent and contained gum are then placed in a closed vessel and the volatile solvent driven off by heat. The gummy mass that will not volatilize in the still or receiver is then washed in water, either warm or hot, and is then subjected to repeated rollings. The gum resulting is of a brown color, highly flexible and elastic, combustible, and seems to possess the characteristics of India rubber, except that it has rather a balsamic odor, differing from the odor of commercial rubber. The gum can be vulcanized by the addition of a quantity of sulphur in the same manner as the India rubber of commerce.

### A Novel Horn for Phonographs.

A single horn is ordinarily used in phonographs to discharge the sounds, the small end of the horn being connected with the short tube of the reproducer either directly or by the interposition of a rubber tube connection. It has been proposed to use two horns communicating with opposite sides of the reproducer diaphragm, with the discharge ends arranged side by side. The purpose of this construction is to improve the tone, quality and power. Furthermore, it has been proposed for a similar purpose to employ a number of independent horns mounted upon a part to which a rotary movement is given. The horn in this case consists of a large bell or hood embracing a number of small horns communicating at their smaller ends with a transmitter having a mouth. A throat leads from the mouth to the diaphragm frame of the reproducer. It is claimed that music,



**CHAIN-PULL ELECTRIC LIGHT.**

vocal or instrumental, is reproduced by this new horn with great clearness, and that the power of every sound is materially improved.

### A Sorely Needed Invention.

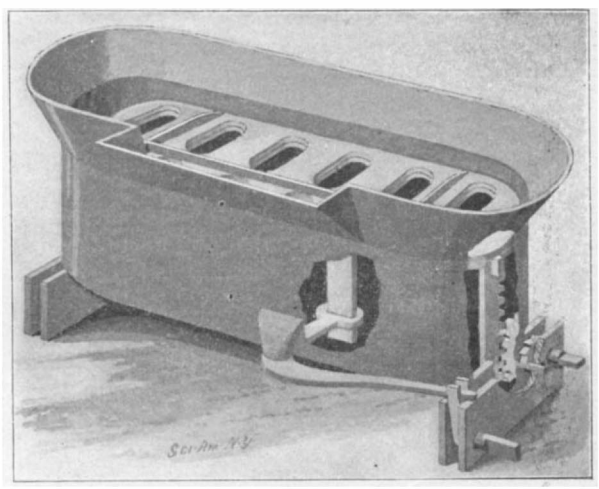
In the manufacture of oilcloth no means have yet been devised for utilizing the waste trimmings. Since the printing machine for the oilcloth must be absolutely to gage, at least one inch to one and a half inches are lost on each side of a strip of material. These trimmings are particularly valuable because they contain a considerable amount of linseed oil; and a method reasonably cheap and economical is wanted to extract this oil from the trimmings.

### A REMOVABLE FIREBOX AND GRATE FOR COOKING STOVES.

A novel form of firebox for attachment to cooking stoves was recently patented by Andrew A. Witz, of Harvey, No. Dak., the construction of which is certainly ingenious.

The firebox is constructed of sheet metal in oval form and is formed with a top flange whereby it is adapted for insertion in a cooking stove. The end walls of the firebox are formed with grooves which are intended to act as guideways for vertically movable rack bars carrying a grate. A slidable portion rests flat upon the grate, both the grate and the slidable portion being provided with slots or openings which, when brought into registry, permit the entrance of air to spread combustion and to permit the discharge of ashes, cinders and the like. The racks of the grate are operated by segment gears keyed on a transverse shaft with which a handle lever can be engaged. By means of the handle, the shaft can be rotated so that the segment gears are caused to raise or lower the rack bars and consequently the grate. The shaft is locked and the grate held in any desired adjustment by means of a ratchet segment and a slidable dog.

The slidable part superposed on the grate is provided with a depending arm engaged and operated by an elbow lever, the outer end of which is loosely connected with the lever of a short rock-shaft having its bearings in parallel plates forming an attachment of the firebox. By oscillating the rock-shaft through the medium of the lever handle, the elbow lever will be caused to reciprocate the sliding portions superposed on the grate. In order to permit such a movement of the superposed part, the grate is necessarily provided with a slot in which the arm previously mentioned works. By reason of the adaptation of the depending arm to slide in a slot formed in the inner end of the elbow lever, provision is made for rocking the grate whatever may be the elevation or vertical adjustment. In other words, the sliding engagement of the bar and lever arm is the same whatever be the position of the grate. It is even practicable to shake the grate while it is being raised or lowered.



A REMOVABLE FIREBOX AND GRATE FOR COOKING STOVES.

This improved firebox, with its grate adjustment, can be used in connection with the old forms of cooking stoves. The firebox is designed to contain any kind of fuel. It is apparent that the openings of the grate and its superposed portion amply provide for the admission of air, and that the draft may be perfectly regulated. By adjusting the superposed sliding part, it is possible to close the openings more or less. When there is a comparatively small quantity of fuel on the grate and the degree of heat corresponds, the grate can be raised to bring the fuel surface nearer to the bottom of the pots, kettles, or other cooking receptacle placed in the stove holes. If there be a comparatively large amount of fuel on the grate, and the combustion and heat are greater than required for cooking purposes, the grate can be lowered in order to lessen the effect of the heat upon the cooking receptacles.

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# Legal Notes.

**The Harvey Patents.**—Following the action of the government in refusing to recognize the validity of the Harvey patents for face-hardening armor plates, comes the filing of a suit in the Court of Claims by the Carnegie Steel Company to recover from the United States all the royalties paid. The question at issue involves the point whether the Carnegie Company was actually required to pay the royalties exacted by the patentees, and whether the contractor was bound by this requirement, thereby rendering the government liable to reimbursement, despite the subsequent declaration that the patent was void. It had been agreed that if the Carnegie Company was to pay royalties for the right to use the Harvey process, the United States would reimburse the company for the royalties, provided the sum thus paid did not exceed one-half of one cent per pound of armor delivered. On April 1, 1899, royalty was paid to the amount of $8,024.45 for 1,604,890 pounds of armor plate. The Carnegie Company demands reimbursement for that amount in accordance with the contract made with the United States government. The United States has failed to live up to its agreement. After the government refused to reimburse the Carnegie Company, the contractor declined to pay any further royalties to the patentees, who have thus far been unable to recover from the Carnegie Company. Consequently the government takes the standpoint that if the Carnegie Company has not yet been obliged to pay any other royalties under these patents, it was not required to pay those which it did pay and for which it now brings suit to recover.

**Simultaneous Expiration of Trademark and Patent.**—It is a well-known principle of law that a trademark right in a patented article expires with the patent, provided that it was not vested in the owner before the application for the patent. Up to the present time the cases to which this principle has been applied have involved merely trademarks and patents in the same country. The question arises: If the patent on the article is granted in one country, and the trademark right exists in another country, does the trademark become public property when the patent expires? The question was recently decided by the Supreme Court of the United States in the matter of the Holzapfel's Compositions Company, Ltd., vs. the Rahtjen's American Composition Company. The evidence showed that some time between 1860 and 1865 a German inventor, John Rahtjen, invented a paint which proved particularly serviceable as a covering for ships' bottoms. Rahtjen sent his paint to England and to the United States, marking it "Rahtjen's Patent Composition Paint." Not until 1873 was a patent secured on the paint. That patent was obtained in England and expired at the end of seven years, because the inventor had not fulfilled certain official requirements. Rahtjen subsequently assigned the right to make his paint to an English firm (the appellant in the present case) and to an American firm (the respondent). The respondent began this suit in equity to restrain the appellant from using the trademark which the respondent averred it had acquired in the name "Rahtjen's Composition." A United States trademark was registered in 1885, subsequently to the expiration of the English patent, and subsequently to the time when the appellant company had commenced to manufacture the paint as "Rahtjen's Composition, Holzapfel's Manufacture," and had sent it to the United States under that name.

Prior to November, 1873, the article was not patented anywhere. Therefore the Court held that a description of it as a patented article had no basis in fact and was a false statement tending to deceive. A symbol or label claimed as a trademark so worded as to contain a distinct assertion which is false will not be recognized, nor can any right to its exclusive use be maintained. After 1873 the words "Rahtjen's Patent Composition" must have referred to the English patent, since there was no other. As the right to use the word depended upon the British patent, the Court believed that the right so to designate the composition fell with the expiration of that patent, and became public property, as a description of the article. The Court found that the name given to the article was essentially descriptive, although the name of the inventor was an element. The inventor had called his product by a certain name. When the right to make it became public, how else could it be sold than by the name used to describe it? And when a person having the right to make it describes the composition by its name, and so distinctly said it was manufactured by him that no doubt could arise, how can it be held, the Court asked, that there was any infringement of the trademark by employing the only term possible to describe the article, the right to manufacture which was open to all? Necessarily the right to manufacture and the right to use the only word descriptive of the article both became public property simultaneously. The exclusive right to use the only name which describes the composition could not be retained after the expiration of the patent; and no such right could be claimed by virtue of a valid trademark antedating the patent, for there was none. To strengthen its position the Court cites the case of the Singer Manufacturing Company vs. June Manufacturing Company, in which, however, both the patent and the trademark were domestic.

**Dental Bridge Verdict.**—Following hard upon the recent Brickell Feed-Water Heater decision, comes a United States Circuit Court verdict which may possibly render many American dentists liable to the International Tooth Crown Company for royalties due on "bridge-work." It seems that Dr. James Low in 1881 obtained a patent for the bridge-work system now followed by all dentists. He sold his invention to Dr. Sheffield for certain annual royalties and for an interest in the International Tooth Crown Company. Dr. Sheffield established a school for the purpose of instructing dentists how bridge and crown-work should be done. By licensing his graduates, he brought down upon his head a hornet's nest of opposition. Dr. Sheffield began a series of suits which, after his death, were continued by his widow. For fourteen years litigation has continued. The sum involved is $10,000,000, which is claimed from the 17,000 dentists practising in the United States. The International Tooth Crown Company has been opposed in Court by the Dentists' Protective Association, which has taken up the cause for American dentists. The verdict rendered in the United States Circuit Court involves merely $500, claimed from the Hanks Dental Association of this city for infringement of the Low patent. But if the decision stands, it is possible that every dentist in the United States who has done bridge-work after the Low method will become liable. It remains to be seen whether the Circuit Court of Appeals will uphold the verdict, if the Dentists' Protective Association, who defrayed the expenses of the Hanks Dental Association, sees fit to appeal.

**Copyright Infringement.**—It is decreed in the English Fine Arts Copyright Act of 1862 that "if any person, not being the proprietor for the time being of copyright in any painting . . . shall, without the consent of such proprietor, repeat, copy, colorably imitate, or otherwise multiply for sale, or knowing that such repetition, copy or other imitation has been unlawfully made, shall sell . . . any copy . . . of the work . . . such person for every such offense shall forfeit £10." In the recent case of Hildesheimer vs. W. F. Faulkner, Ltd., which was an action brought to restrain infringement of the copyright by the defendants and to recover damages for the circulation of 1,012,600 copies of the plaintiff's pictures, it was decided by the trial court that the plaintiff was entitled to a penalty for each copy circulated, and that since this penalty must be some recognized actually existing sum in coin, the court felt itself constrained to fix the penalty at a farthing for each copy. The defendants appealed. It was stated that the cost of producing a million copies of the picture was only about £100. The questions to be decided on appeal were: (1) Whether the order for the printing of a million copies constituted a million offenses or only one offense. (2) Whether, if each copy constituted a separate offense, the penalty should be fixed at one farthing for each copy put in circulation, which would amount in the whole to £1,054 15s. 10d., or whether it should be fixed at some smaller fraction of a penny for each copy. Lord Justice Rigby held that the Court was not bound to fix a sum made up of separate sums which would have been recovered if there had been a separate action for each offense. Lord Justice Collins, although holding that the defendants were technically within the law and that they had become liable in respect of a million copies, construed the statute to mean that a maximum and not a minimum penalty was inflicted. His lordship could see no reason why in such a case the penalty should be limited in reference to a coin. In the present case the execution could only be for the aggregate sum. Lord Justice Romer, holding with his colleagues, found that if the statute were to be construed too literally the Court might be bound to award a sum which would obviously be far in excess of that which ought to be given, and the judgment would be doing that which the Act had carefully avoided doing, namely, fixing a minimum penalty. His lordship could see no reason why, when the action was brought for a number of offenses, a sum should not be given which, when divided by the number of offenses, would give for each a fraction of the lowest coin of the realm.

## RECENTLY PATENTED INVENTIONS.

### Engineering Improvements.

STEAM-GENERATOR. — ROGER DAMONTE, deceased, JOSEPH A. R. DAMONTE, Administrator, 7007 Magazine Street, New Orleans, La. The steam-generator is of the type having one or more coils or convolutions, through which water circulates from a standpipe. The novel feature of the present improvement is the provision of a rotary valve for controlling the escape of steam from the several pipe coils, whereby the latter can be conveniently cleaned whenever required.

### Special Implements and Devices.

REIN - HOLDER. — CARL P. UHLMANN, Quincy, Ill. The rein-holder is characterized by its simplicity of structure and by the ease with which it can be attached to a dashboard or any other convenient part of a buggy. The reins are imprisoned between two cylinders which are eccentrically pivoted on a plate, one end of which is bent over to form a guard. Disposed within the guard and connecting the cylinders is a spring, which expands and permits the reins to be easily inserted between the cylinders, and the elasticity of which holds the reins clamped with slight pressure.

TURPENTINE HACK AND SHAVE.—JOHN P. COUNCIL, Jr., Wananish, N. C. In removing the crude turpentine gum from pine trees, a peculiar tool called a "hack" is employed. The present invention provides a new form of hack which is adapted for adjustment of its cutting blade. The blade can be projected more or less from the handle and held at any desired inclination.

FORCEPS.—DAVID F. BOWERSOX, Aaronsburg, Pa. The forceps are designed especially for veterinary use in performing operations in the throat of an animal. The construction of the instrument is such that operations can be performed without in any way endangering the animal by laceration.

### Mechanical Devices.

HEMMING AND HEMSTITCH ATTACHMENT.—JOSEPH W. SIMONS, Portchester, N. Y. Heretofore it has been necessary to crease and baste the hem down in order to bring the hem to a line with the drawn threads and to have the ends even, when the operation of hemming is accomplished. The improved device dispenses with the operation of creasing and basting and produces more perfect work. Any resistance or friction on the material is avoided. In circular articles (pillow-cases and skirts) the fold-gage is turned from within the fold or hem. The operator can start from any point on the garment and continue around to a point about the width of the hem from the starting point.

CURTAIN-SHUTTER. — WILLIAM F. FOLMER, Manhattan, New York city. Mr. Folmer has invented an improved curtain-shutter which can be set for time or for instantaneous work, and which is arranged to give a continuous or time-varying exposure of the plate, according to the intensity of the light. Thus for a land and sky subject the darker land foreground is subjected longer to the actinic action of the rays of light than the sky portion; and the entire exposure is continuous and uniformly graduated to insure an even or gradual exposure of the plate. The characteristic feature of the shutter is an exposure opening arranged to be gradually increased in size while moving over the field of exposure.

RAZOR-STROPPING MACHINE.—ALBERT L. SILBERSTEIN, Manhattan, New York city. The inventor has devised a razor-stropping machine which will readily accommodate handled-razors having blades of different sizes. The razor can be conveniently placed in position in the holder and securely held. The machine gives the blade the desired inclined position while drawing it over the strop in either direction, so as to present the entire cutting edge of the blade to the strop at each forward and backward movement.

SPOKE-TENONING AND CUT-OFF MACHINE.—DEFIANCE MACHINE WORKS, Defiance, Ohio. Mr. Charles Seymour has invented for the Defiance Machine Works a spoke-tenoning and cut-off machine which is designed for builders of heavy wagons. The machine is arranged to cut off the tread ends of the spokes to equal length, to reduce a wheel to the proper diameter, to cut the tenons of any desired size on the ends of the cut-off spoke and to finish the ends completely to receive the fellies.

AUTOMATIC WHEEL-RIM-FINISHING MACHINE.—DEFIANCE MACHINE WORKS, Defiance, Ohio. Like the spoke-tenoning and cut-off machine described in the foregoing notice, the present machine, which is also an invention of Mr. Seymour's, is designed to be used by builders of wagons and makers of wheels. By means of this machine the tread of the wheel is very precisely dressed, and accurately finished relatively to the hub. The sides of the rim can be planed either straight or to a bevel, leaving the rim perfectly smooth so as to require no hand labor.

CUTTER-HEAD. — DEFIANCE MACHINE WORKS, Defiance, Ohio. In connection with the previously-mentioned spoke-tenoning machine, Mr. Seymour found it necessary to invent a novel cutter-head for the particular work which was to be performed by that machine. The body of the cutter-head for the particular work which was to be performed by the machine. The body of the cutter-head has radial guideways in which the cutter-carriers slide. On the body a cam is mounted to turn, having on its face a spiral cam engaging teeth on the carriers. Bolts are passed through the body to hold the cutter-carriers rigidly together. The operator can move the carriers and consequently the cutters outward or inward to cut miters of the desired thickness.

APPARATUS FOR FLOATING VESSELS.—ALBERT S. DEBOSE, Cuero, Tex. The invention relates to a means for assisting in floating vessels that have run aground; and it consists in certain novel mechanism for raising or partly raising the vessel, combined with means for hauling the vessel aft when it has been so raised. Beams provided with racks are adapted to work vertically on the side of a vessel, which beams can be raised and lowered as well as guided vertically. A hauling rope is connected with the foot of each beam. A pulley is attached to the vessel's hull at one end, the rope extending back over the deck. By adjusting the various beams and forcing them downward the vessel will be wholly or partly raised; and when this has been done, by hauling on the ropes the beams will be tilted and the vessel moved astern or forward, as the case may be.

### Miscellaneous Inventions.

SURVEYOR'S SOLAR COMPASS.—JOSEPH B. PORTER, Berryville, Ark. The inventor has sought to devise a surveyor's compass which will not be subject to the defects of the magnetic needle. Two regular and systematic changes (secular and diurnal) must always be calculated and allowed for in the use of the magnetic needle. These separate each survey from its predecessor over the same lines, necessitating a random or trial line to re-establish the variation of the needle. By reason of local magnetic ore and electrical disturbances, the magnetic needle is apt to be erratic, and, therefore, untrustworthy at times. The present invention is designed to overcome these difficulties and to that end provides a compass without a magnetic needle. The north and south positions are established through observations taken from the sun in its relation to the earth.

HAND-TRUCK.—HENRY DEERING, Minnesota City, Minn. The hand-truck is of the kind used for the transfer of goods and bagged material from point to point. Novel features of construction are provided by which the truck is adapted for the reception and movement of large loads and their discharge in a proper manner. An adjustment of the parts is permitted to adapt the truck for ordinary use.

CARBONATING APPARATUS.—EDWIN C. WORNS, Manhattan, New York city. The invention relates to an apparatus for carbonating or aerating water in which a container is provided for the water. In this container a chamber is situated through which the water and gas are successively passed, the chamber containing pebbles or some finely-divided substance to facilitate the aeration of the water.

FIRE-EXTINGUISHER. — FERNANDO YOST, Rutherford, N. J. A reservoir or tank is provided of sufficient size to enable it to be conveniently carried to a fire. The reservoir is filled with a liquid, which may be either plain water or a chemical solution. The device is provided with a pump and short hose by which the liquid is thrown to the point desired.

FILE-CLEANER. — GEORGE W. SCHELLENBACH, Joplin, Mo. The invention relates to a structure for cleaning files—that is to say, for removing from between the ridges of the file such matter as may accumulate therein. Mr. Schellenbach has devised an arrangement of alternating layers of open-work metal material and cloth, such parts being secured together and worked edgewise against the file.

FILE-HANDLE AND GUIDE.—TIMOTHY W. MILLER, Phœnix, Ariz. This file-handle has a novel device which guides the reciprocating movement of an attached file used to sharpen the teeth of saws, whereby any desired degree of bevel can be given to the cutting edges of the saw-teeth, and a suitable rake or forward pitch to the teeth.

NIPPLE.—FERDINAND MUELHENS, Cologne, Germany. Ordinary rubber nipples for milk bottles are in a very short time squeezed flat, and must be released by the child to permit the rubber to re-expand and the milk to flow. This operation tires the infant and chills the milk by reason of the entrance of atmospheric air. Solid rubber nipples would not be so objectionable, but cannot, on the other hand, be readily or thoroughly cleaned. The present invention relates to an insertion-piece for the usual rubber nipple which has for its object to obviate all drawbacks. Only when the sucking power of the child is no longer sufficient to take up the liquid contained in the bottle, is the taking of food interrupted.

SAD-IRONS.—MICHAEL JOYCE, Salt Lake City, Utah. The handle can be attached to or detached from the iron at will, so that one handle can serve for a number of irons. Two of these sad-irons have been invented by Mr. Joyce. In the first the base has a longitudinal groove, at each side of which a recess is formed having an undercut portion. The groove has a cavity in its bottom. The handle has a bar capable of lying in the groove of the body; and the bar has transverse projections adapted to enter the undercut portions of the recesses. A spring-pressed dog is mounted on the bar and has its nose adapted to project through the bar to engage in the cavity in the base. In the second sad-iron the handle has two parallel bars arranged one above the other; the lower bar has projections lying in the undercut walls in the groove in the body and has also a T-shaped groove at one end of which an opening is located. The dog is set in the groove and conforms with the shape, the transverse part or T-shaped head of the dog forming a pivot and the bill of the dog at the opposite end extending through the opening in the lower bar, whereby to engage the body.

RAILROAD OR STEAMBOAT TICKET.—GEORGE B. EDGAR, Jr., and BENJAMIN F. DAVIS, Winfield, Kans. With this ticket an agent's stub contract and coupons are combined, forming a portion of the ticket, the ticket being in the form of a double sheet. This ticket when sold cannot be resold through a "scalper," or transferred to another person without the conductor or person collecting the tickets being enabled to detect the transfer.

CARD-HOLDER AND MEMORANDUM-BOOK.—DAVID T. HELPRIN, Manhattan, New York city. The object of the invention is to provide a card-holder and memorandum-book arranged conveniently to hold visiting cards, business cards, and the like, and to provide detachable leaves for noting memoranda. When the memorandum-book has been used up, a new one can be substituted, and the old leaves torn out.

BAND AND SHOE FOR TANKS.—JAMES HATTELY, Seattle, Wash. Mr. Hattely has devised a contractible band or hoop to hold the staves of a tank together. The band is strengthened where one of its ends engages with the abutting shoe therefor, so as to render the band very strong and durable at a point which is weak in bands of ordinary construction.

DISPLAY-RACK.—GUIDO HECKER, Manhattan, New York city. The rack is to be used for display-bottles containing extracts, medicines or the like, candies, wax, etc. The rack is light, yet strong and serviceable, comparatively cheap to manufacture and can be used as an advertising medium so as both to display and advertise the goods, thereby obviating the use of extra banners and signs.

EXHIBITOR FOR PICTURE-FRAME MOLDINGS.—CARL. A. ANDERSON and GEORGE D. PALM, Worthington, Minn. By means of this improved apparatus one or more picture-frame moldings can be conveniently examined and the effective frames made of different moldings when seen with the same picture can be quickly determined. A distinguishing feature of the apparatus is an arrangement of mirrors vertically at a horizontal angle to one another and the provision of supports on the mirrors for the frame moldings to be exhibited. The mirrors revolve horizontally and receive or admit a picture beneath them so that the picture is reflected in the mirror with a particular molding.

SHADE-BRACKET.—WILBERT O. PERSON, Marinette, Wis. The opening for the roller-stud is so constructed as to permit the ready insertion and removal of the roller-stud when the bracket is tilted or slightly turned on its pivot. The bracket is pivotally mounted and has its opening for the roller-stud formed on the face next to the roller with an inclined surface leading to the stud opening, and arranged to guide the stud into the opening and to furnish a path through which the stud may be removed when the bracket is tilted.

### Designs.

DISPLAY-BOX.—TERENCE F. CURLEY, 12 and 14 Warren Street, Manhattan, New York City. The display-box has as its essential feature a concave top which is inclined. In this concave top a pen-knife or similar article is to be laid for the purpose of advantageous display.

HAMMER.—HARRY MCDERMOTT, Chicago, Ill. The outline of the body and the claw is continuous and unbroken. This is secured by extending the front edge of the body in an unbroken line straight for a portion of its length from the lower end of the head to a point where it crosses the line of the head-shank, and then curving rearwardly. The claw is a distinctly novel formation, having a greater length and sharper inclination than the ordinary hammer. By means of this novel claw nails can be readily removed.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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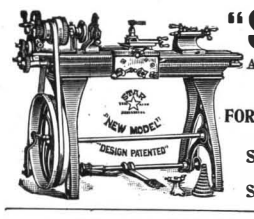

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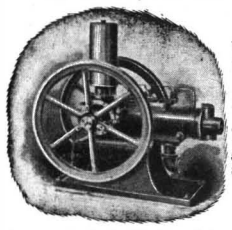

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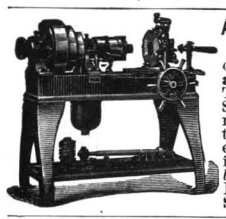

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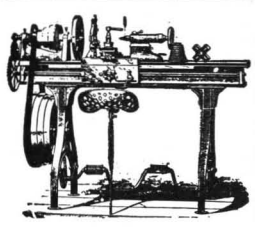

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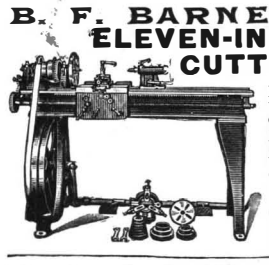

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# Notes and Queries.

HINTS TO CORRESPONDENTS.

**Names and Address** must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

**References** to former articles or answers should give date of paper and page or number of question.

**Inquiries** not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

**Buyers** wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

**Special Written Information** on matters of personal rather than general interest cannot be expected without remuneration.

**Scientific American Supplements** referred to may be had at the office. Price 10 cents each.

**Books** referred to promptly supplied on receipt of price.

**Minerals** sent for examination should be distinctly marked or labeled.

(8454) J. W. McD. asks: Where can I obtain the best works on building up-to-date, modern electric generators and motors of small sizes, of from 45 to 110 volts? Twenty to fifty 16-C.P. lamps. A. The most recent work giving plans of dynamos is a book called "Electrical Designs," price $2 by mail. This does not contain large machines. The plans for these can hardly be found outside of the shops of the companies engaged in manufacturing them, for the reason that they cannot be built economically by amateurs. It would not pay to publish such a work because each company has its own designs, made by its own engineers.

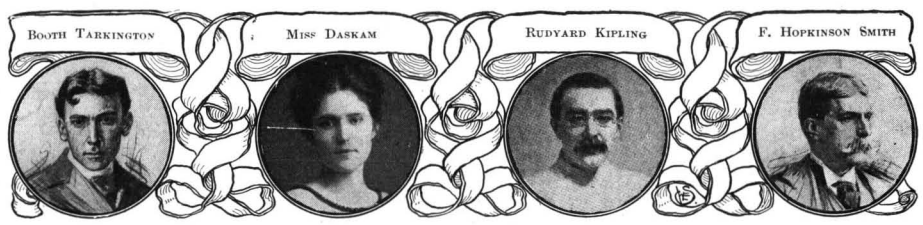
(8455) I. S. W. asks: 1. At what temperature does frost form? A. At 32 deg. Fahr. 2. In magnetizing a piece of iron or steel with a permanent magnet, does the permanent magnet lose any of its magnetism? A. No. On the contrary it tends to strengthen the magnet. 3. What horse power engine is required to run the 8-lamp dynamo of SUPPLEMENT No. 600? A. Three-fourths horse power. Also what horse power to run the 110-volt dynamo of SUPPLEMENT No. 865? A. About one horse power. 4. How is the horse power of a windmill calculated? A. Approximately by multiplying the area of the slats in the plane of revolution by the cube of the velocity of the wind in feet per second, and divide the product by 4,000,000.

(8456) G. L. M. asks: 1. Please give me the difference between Eastern, Central and Western standard time and where it is changed. A. Eastern time has the 75th meridian west of Greenwich as its central line and is 5 hours behind Greenwich time. Central time has the 90th, Mountain time the 105th, and Pacific time the 120th meridian as its center. Theoretically the meridians half way between those above named are the lines where the change of time is made, and each is one hour earlier than the next to the east. Practically the convenience of the railroads controls the matter in the United States. Thus, the change of time is made at Buffalo on roads starting from that place, east or west. It is made at Pittsburg for roads having that as a center. This is better than changing the running time an hour at some small way station. The line north and south along which the time changes is not a straight line. 2. Also the difference between Eastern, Central and Western sun time and where it is changed. A. Sun time is the time at the particular place. It is noon by the sun when the sun is exactly south of one, and clocks which are set to sun time are said to keep *local time*. This is not called eastern or western. It is the time of that meridian only. It is the same local time upon a line due north or south over the earth. For a change of one degree of longitude the local time changes four minutes, being four minutes earlier for each degree to the west, and later by the same amount for each degree to the east of any place. This is the time that was kept everywhere in the world before standard time was introduced. Now nearly the whole civilized world has standard time based upon the meridian of Greenwich.

(8457) W. B. M. asks: 1. What is the nature of the conductivity of selenium in carrying a current of electricity, as affected or influenced by light? A. We do not know the nature of electrical conductivity in any substance. 2. Does the exposure or influence of light act on selenium gradually or instantaneously? A. All action of light is practically instantaneous. 3. Is selenium a non-conductor in the dark, i. e., absence of light? A. Selenium is to be classed among non-conductors. 4. Do any particular colors or rays of light affect it more quickly than others? A. We have no data at hand on this point. The best method of learning all about selenium is to go to some first-class library and go through the reports of learned societies. You will then have it all. We can send you articles in our SUPPLEMENT Nos. 462, 484, 492 and 1348 for ten cents each.

(8458) E. H. H. writes: I wish to break an electrical circuit a certain number of times in a second by means of a spring and electro-magnet, something like the electric tun-

(Continued on page 354)


# McClure's Magazine

## FOR 1902

*1902 promises to be a year of interesting and important human achievement. This will make McClure's Magazine rich, for it is McCLURE'S special purpose to describe the newest things in science, invention, and discovery while they are interesting. Because the achievements of 1902 are not yet accomplished, the prospectus of a magazine that keeps in touch with life cannot be complete.*

### A NEW NOVEL BY BOOTH TARKINGTON

**Author of** "The Gentleman from Indiana" and "Monsieur Beaucaire" will shortly begin publication in McCLURE'S MAGAZINE. It is a beautiful and romantic love story, of love thwarted but triumphant, of gallant men and beautiful women. The scene is laid in Indiana at the time of the Mexican War.

### TRUE STORY OF STANDARD OIL

By IDA M. TARBELL

**Author of** Life of Napoleon, Life of Lincoln and Civil War Papers which have been immensely popular, because she looks at history and writes history in an intensely human way. In this spirit she tells of the struggles, the tremendous fights, the moves and countermoves that caused this company to rise to supremacy and keep it the greatest of the trusts. She goes back to original sources for material as she did for her other works. This immense corporation, perhaps the richest company that has ever carried on business in any land, has wonderfully modified conditions of life to-day. No history of the present generation can be complete or even intelligible without an account of the developments and progress of the Standard Oil Company. Its history of forty years is an extraordinary record of business sagacity and daring push, of striking and dramatic episodes. It is a stirring, wonderful story filled with all kinds of human interest. Miss Tarbell will treat it as history in her delightful sympathetic and vivid manner. She will give us, not an economic treatment, but a true story, interesting in the highest degree and vastly significant.

### TWO AMERICAN NOVELETTES

**The Forest Runner**

By Stewart Edward White, begins this month. The tale of a race and manoeuver for a forest claim in the woods of Michigan—a fresh, clear-cut American story, absorbing, even thrilling in its succession of incidents.

**A Battle of Millionaires**

By Edwin Lefevre. The story of the most remarkable fight that ever occurred in Wall Street.

### "MR. DOOLEY" ON HIS TRAVELS

Mr. Finley P. Dunne has been taking his friend Mr. Dooley around among the cities, showing him the inhabitants of New York, Boston, Philadelphia, Washington and Chicago. Now Mr. Dooley, in spite of the comical way he says it, is a fair-minded person, sane, shrewd and kind. Though he may make us laugh at him, he has a way of turning the joke back upon ourselves, and leaves us with something to think seriously about; it is the man behind the laugh that exerts a far-reaching influence and gives the humor permanent value.

**Reminiscences of a Famous Journalist**

For thirty years George Washburn Smalley was the chief American newspaper correspondent in Europe, received everywhere, enjoying the confidence of statesmen, the companionship of generals in the field, the friendship of writers and actors. Mr. Smalley writes a series of articles on the people he knew—the late Queen Victoria and Lord Salisbury, George Wyndham, Asquith, Lord Rosebery, Sarah Bernhardt and Sir Henry Irving, Mrs. Kendall, Browning, and Bismarck, and Gambetta, treating them in groups—statesmen, literary and stage folk.

**Clara Morris**

Will continue her vivacious and charming papers, taking for subjects Salvini, Henry Bergh, Sarah Bernhardt, Rachel, etc.

**William Allen White**

Will write of such men of the day as Quay, Platt and others, without the partisan bias of the day. That he can do this he has shown in his portraits of Bryan, Croker, Hanna, and Roosevelt. Mr. White is clear-eyed, honest, fearless and genial. He strikes for the real man who stands misunderstood between the admiration of his friends and the prejudice of his enemies, saving him for the future; and he does it in a form that will last.

### BORDER FIGHTS AND FIGHTERS

**Cyrus Townsend Brady**

will furnish articles on Daniel Boone, David Crockett, Sam Houston, Kit Carson, George Rogers Clark, John Sevier—the men who built the foundations of the present United States and carried the frontier farther and farther west.

### NEWEST SCIENCE and EXPLORATION

**Marconi's Latest Discoveries in Wireless Telegraphy**

As told by himself, will disclose some matters never before revealed to the public, the result of two years spent in perfecting his invention.

**Edison's New Storage Battery**

Will be the subject of an article by Ray Stannard Baker, which will tell at first hand of an invention which is almost revolutionary in its character.

**The Wonders of Modern Surgery**

By Samuel Hopkins Adams, will set forth the latest developments in a science which has been making wonderful progress in prolonging human life.

**Transportation in the Great Cities**

Wm. Barclay Parsons, chief engineer of the new underground railway system in New York, will compare the various ways London, Paris, Berlin, Boston, Chicago and New York are solving the problem and will tell of the thousand and one difficulties of every imaginable nature which beset those who plan and execute these great undertakings.

**With Baldwin to the Pole**

With the most completely organized expedition ever sent out E. B. Baldwin hopes to reach the Pole during the year. McClure's Magazine will publish the account of his success, as well as any other important tidings he may send back in the meantime. Nansen says he cannot fail.

**A New Race of Forest Dwarfs**

(not merely a new tribe) has been discovered in Central Africa. Sir Harry H. Johnston, the discoverer, will describe these strange men, and his own photographs and drawings will be reproduced.

**Many of the Best Features**

Cannot be described in advance, as they will be secured as great issues arises.

### THE GREATEST of the OLD MASTERS

By JOHN LA FARGE

This modern master will write with the authority and understanding of a painter, the clearness and charm of a literary artist, on the great painters, Michael Angelo, Raphael, Rembrandt, Velasquez, etc. The first article of the series is in this number of the magazine. He personally oversees the illustrations, which will be reproductions in tint and black of

THE WORLD'S GREATEST PAINTINGS.

### OTHER FICTION

**Rudyard Kipling**
New Stories in the old virile manner.

**George Ade**
Humorous Stories with also deep meaning.

**F. Hopkinson Smith**
[illegible] of a typical American Sea Captain.

**Joel Chandler Harris**
Tales of Southern Life and Character.

**Hamlin Garland**
Indian Stories, picturesque and realistic.

**Octave Thanet**
Western Stories that stir with Western spirit.

**Jack London**
Adventures in the wild Northwest.

**W. D. Hulbert**
Animal Stories (The Lynx, The Trout, etc.).

**Norman Duncan**
Tales of Fishermen and the Sea.

**Josephine Dodge Daskam**
More stories about boys and girls.

**George Madden Martin**
Emmy Lou Stories.

Among the other short-story writers of the year will be Anthony Hope, Henry Van Dyke, Sara Orne Jewett, Mary E. Wilkins, Robert Barr, Mary Fulton Cutting, Booth Tarkington.

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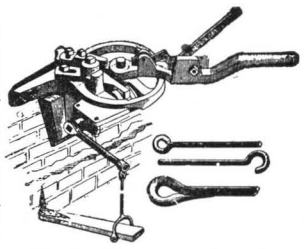

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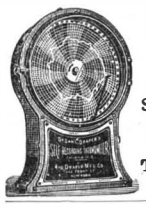

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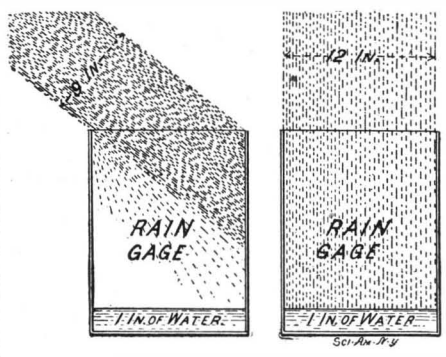
ing fork, but only using one leg of the fork. What number of vibrations (double vibrations) is it possible to attain? C of the treble clef has 517.3 double vibrations in a second. Would it be possible to attain four octaves above that =8,276.8 double vibrations; that is, break the circuit that number of times? A. With that number of breaks per second the current would be apparently continuous. A dynamo making 1,800 turns per minute makes 30 turns per second, and if there are 24 coils on the armature, there are only 720 impulses of the E.M.F. per second. We call such a current continuous, and it has not a tenth of the impulses you name.

(8459) B. C. B. asks: Can you furnish me a book of instruction on the wiring of an electric light plant that explains fully the testing of lines for breaks, that explains the arc lamps, the incandescent lamps, the transformers and everything about an electric light plant? I have a book from your house, "The Practical Management of Dynamos and Motors," but it does not explain the wiring, lights and transformers. If you have such a book, what is the price? A. There is no single book which covers the range of topics upon which you desire information. We can furnish the following: Crocker's "Electric Lighting," Vol. 1, "The Generating Plant," price $3; Vol. 2, "Distributing System and Lamps, $3; Herrick's "Switchboards," $3; Kilgour's "Electrical Distribution in Theory and Practice," $4; Kapps' "Transformers," $1.75.

(8460) B. A. T. asks: 1. How many ampere hours will a Fuller battery give? A. About 68 ampere hours. 2. Does a Fuller battery give the same voltage after it has been charged some time as it does when it is freshly charged? A. No. 3. Does a porous cup that is used in batteries wear out? A. No. Does battery carbon wear out? A. No.

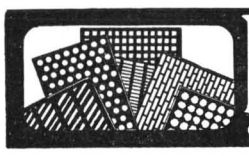
(8461) J. R. T. writes: In your Notes and Queries, 8404, C. N. M., you say that a rain gage will register the same whether the rain is falling straight down or obliquely. I fail to understand why you say this. Let us suppose the rain gage is 12 inches in diameter and the rain was falling in a solid straight down, then 12 inches of rain would go in the gage; but supposing the gage was not level, but stopped at an angle of say 45 degrees, there could not be room for 12 inches of water to come perpendicularly into the gage. Reversing this, if the gage is bent and the rain is falling obliquely, or at an angle of 45 degrees from perpendicular, the result would be the same. If the gage is 12 inches wide, the body of rain, if a beating rain—or falls sloping—must not be over 11, 10 or 9 inches in diameter to go in, because the mouth of the 12-inch gage will not have a capacity of over 11, 10 or 9 inches, according to the slope of the rainfall. I have used common, every-day language to explain my position. See if I am right or wrong. Take a square or round box, any size in diameter, hold it in front of you and it will indicate say 12 inches. Now slowly turn it one side, still looking at it; the top or opening will look smaller and smaller until it will not look half as large. A. We regret that we cannot reach the same conclusion as our correspondent. We of course agree with him that all the rain gets into the gage when the rain falls straight down. We also think the same quantity gets into the gage when the rain falls slanting. When the rain falls at a slant the lines in which the rain falls are brought nearer together than when it falls straight. Suppose that the same quantity of rain falls in two showers on a field; in one it falls straight, and in the other at a slant. In the second the drops will be nearer together, and the same quantity will fall on one square foot. A diagram will make this plain.




(8462) A Reader asks whether or not 8-inch and 13-inch guns in the superimposed turrets on the battleship "Oregon" are constructed to permit of elevation and lowering in aiming and firing. A. There are no superimposed turrets on the "Oregon," each pair of 13-inch or 8-inch guns being in separate turrets; all of these guns are so mounted and the turrets so constructed that a considerable range of elevation and depression is possible.

(8463) H. E. G. asks: What will a voltmeter register when placed in series with a 110-volt, ½-ampere lamp (on 100-volt circuit)? A. A voltmeter in series with a lamp as above stated will register nearly the whole voltage, perhaps 106 volts. This is because the resistance of the voltmeter is very large as compared with that of the lamp. There

*(Continued on page 355)*

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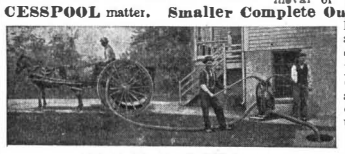

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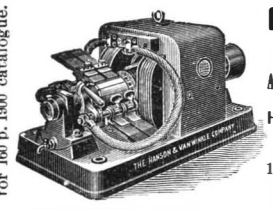

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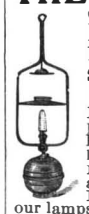

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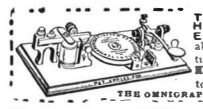

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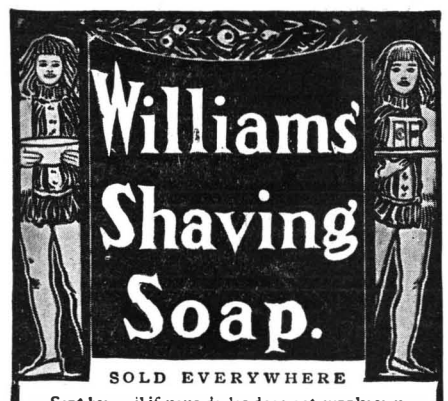


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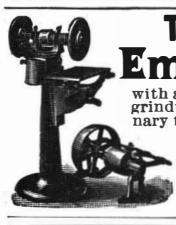

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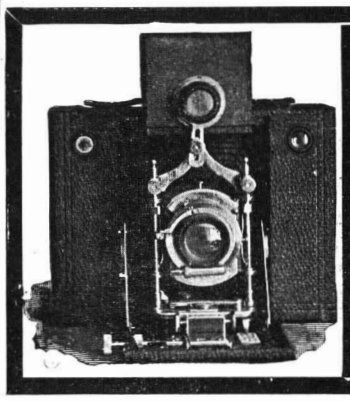
are 110 volts between the terminals of the circuit. This drop takes place through a lamp and a voltmeter, in proportion to the resistance of each. The lamp has a few hundred ohms, and the voltmeter several thousand ohms, hence most of the drop is in the voltmeter. In a measurement we just made we had 115 volts; the lamp took 5 volts, the voltmeter took 110 volts. The voltmeter had 14,013 ohms. We did not measure the cold resistance of the lamp. The current shown by an ammeter was one-hundredth of an ampere, and of course little heat was produced in the lamp. Both instruments were Weston standard instruments and our results are correct. You can easily calculate the resistance of the lamp, of course. In issue of October 26, in replying to A. D., you stated that the voltage of a circuit was not affected by a rheostat. Now, is not the drop in volts equal to amperes × ohms? So if a rheostat of 20 ohms R. carrying a current of one ampere were placed in a circuit, would not that reduce the voltage 20x1 or 20 volts? A. The voltmeter in this case is simply a very large rheostat. It therefore leaves very little drop for the lamp, not enough to light it at all. It does not affect the voltage of the circuit. That remains 110, under any and all arrangements for disposing of it. In the case you cite, if one ampere is to flow through a lamp on a circuit of 110 volts pressure, and the lamp has but 90 ohms of resistance, a rheostat of 20 ohms must be put into the circuit in series with the lamp. There will then be 110 ohms in the circuit, and 110 volts will force a current of 1 ampere through 110 ohms. Now a voltmeter across the terminals of the lamp will show a drop of 90 volts, and across the terminals of the rheostat a drop of 20 volts, making 110 volts across the whole circuit. The rheostat does not reduce the voltage of the circuit. It only takes a part of the drop into itself, so that there may not be too large a drop in the lamp. A voltmeter must be placed in shunt in order to get a reading of drop of voltage with it, not in series as you desired us to place it.

(8464) C. F. J. writes: In your Notes and Queries column of October 26, your correspondent A. A. D. discusses in Query No. 8403 the question whether iron in the direct rays of the sun on a hot day becomes hotter than the air, and quotes Dr. Wiley to the contrary. You reply, "Test the temperatures and find what they are." This may not be easy to do in the case of iron, but it is easy to do with mercury. Place a thermometer in the shade, and it indicates, for example, 98 deg. Move it only a few inches to direct sunlight, and it is very likely to go up to 120 deg. It will not be claimed that the air is so much warmer. The wind may be blowing several miles an hour, and the time of its passing from the first to the second position of the thermometer may be only a thousandth part of a second. It cannot be supposed that the air changes twenty or more degrees in temperature in that brief interval of time. Yet the mercury in a few minutes goes up to that extent. If the mercury becomes 20 degrees hotter in the sunlight than the air, why may not the iron do the same? Being black and dull it may naturally be supposed to absorb even more heat than the mercury. If Dr. Wiley or any one else can explain this any differently your readers would doubtless be glad to hear from him. A. The temperature of the air must be that indicated by a thermometer at the place of observation. If in the shade a thermometer indicates 98 deg. and when moved "only a few inches into direct sunlight" it indicates 120 deg., we see no escape from the conclusion that the temperature in the sun's direct rays was 120 deg. As we understand it, we base our knowledge of temperature upon the thermometer, and not upon our judgment of what we think the temperature ought to be. It has many times been pointed out that several objects at the same temperature do not feel equally hot, because our feelings are produced by the rapidity with which a body can communicate its heat to us. It is a matter of conduction only. Silver, iron, wood and air in the same oven will feel very differently. Silver will burn the skin at a little above 150 deg. Fahr. It will burn the tongue at 150 deg. Iron must be hotter than that to burn us. Wood can be handled at 200 deg. or above, while men have been into ovens at 600 deg without injury.

(8465) H. J. H. writes: 1. Kindly explain why, when you shock yourself with a five-bar generator, and put one finger on one binding-post and another finger on the other, the shock is more severe than having one finger on the two alone (binding-post). A. because the path is longer and the nerves receive more shock than when the path is shorter through the body, from one binding-post to the other. 2. Why is a generator stronger when turning to the right than turning to the left? A. It may be that the earth's magnetism assists that of the field in one position and acts against it in the other position. There is no reason in the machine itself why it should generate more in one direction than in the other.

(8466) T. D. asks: Will you please tell me the resistance and safe capacity of copper wire No. 36 B. & S. gage? A. At 68 deg. Fahr. the resistance of No. 36 B. & S. copper wire is 2,414 feet per ohm. It will carry between two and three amperes in the open air without charring the insulation



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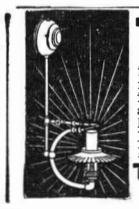

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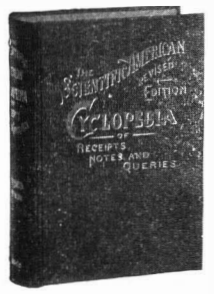


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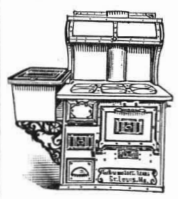

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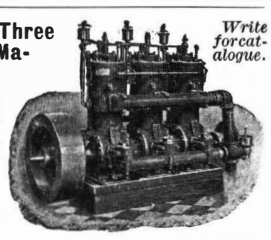

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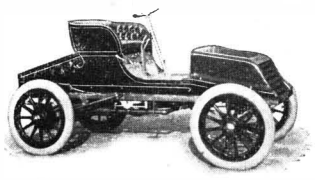

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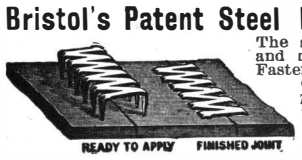


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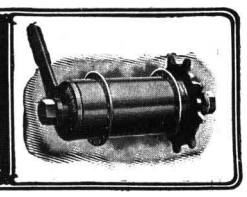

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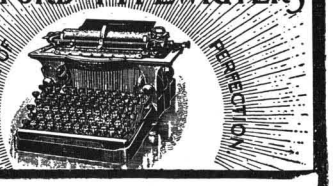


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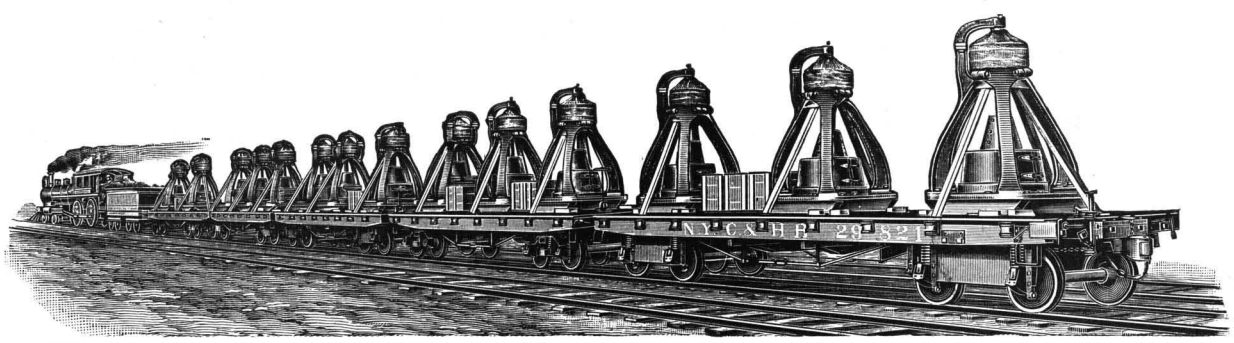

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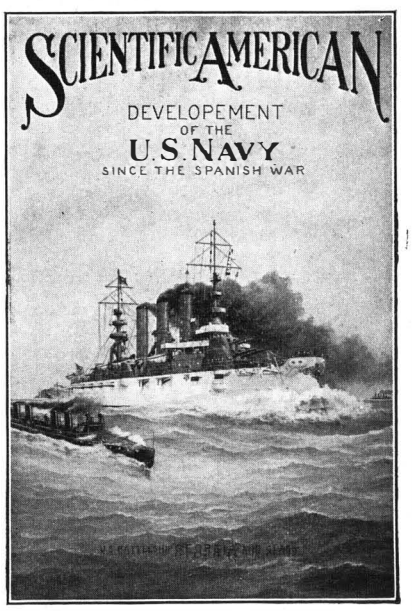


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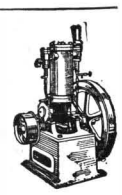

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